IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

ROBERT S. GARNER, on behalf of himself and all others similarly situated	)	
	)	**CIVIL ACTION NO. 1:23-cv-3097**
Plaintiff,	)	
v.	)	
GLOBAL PLASMA SOLUTIONS, INC.,	)	C.A. No. 1:21-cv-00665-SB Case filed in the United States District Court for the District of Delaware
Defendant.	)	

RESPONSE IN OPPOSITION TO DEFENDANT GLOBAL PLASMA SOLUTIONS INC.'S MOTION TO COMPEL

Respondents, Brent Stephens ("Stephens") and Yicheng Zeng ("Zeng"), by their attorneys, Phillip J. Zisook and Kelly Cronin of Schoenberg Finkel Beederman Bell Glazer LLC, respond in opposition to the Defendant-Movant, Global Plasma Solutions, Inc.'s ("GPS") Motion to Compel as follows:

I. INTRODUCTION AND UNDERLYING FACTS

GPS' Subpoenas directed to non-parties Stephens and Zeng,[1] seek "all documents and communications" from 2019 through the present, related to a published academic study Stephens and Zeng conducted in 2021 (the "IIT Study"), including non-public research, raw data, lab protocols, peer review and editor comments, and drafts. (Exs. 1 and 2 hereto). The Subpoenas also demand "all documents and communications" in that time frame which relate to (i) the IIT Study;

[1] Stephens is the Department Chair of the Illinois Institute of Technology's Department of Civil, Architectural, and Environmental Engineering and Zeng is a third year PhD student assisting Stephens in his academic studies. A copy of Stephens' curriculum vitae is attached hereto as Exhibit 3. Neither Stephens nor Zeng have been retained by either party in *Garner* to provide an expert report or opinion, nor were they subpoenaed for deposition in the case.

(ii) a Second IIT Study of Stephens and Zeng; (iii) GPS; (iv) GPS' air ionization products; (v) the "NPBI" ion-based technology used in GPS' products; (vi) whether GPS' products produce or do not produce byproducts; and (vii) a Corrigendum regarding an appendix to the 2021 IIT Study (collectively, the "Subpoena Requests"). When viewed against the issues framed in the *Garner* Complaint (Ex. 4 hereto), namely, (i) whether GPS' representations concerning the efficacy of its air ionization products ("GPS Products") are materially false (Ex. 4, ¶¶53, 71, 140-43, 149-50, 183-85, 188-89), and (ii) whether the plaintiffs reasonably relied on the representations to their detriment, the Subpoenas are impermissibly overbroad, non-proportional, and chill academic freedoms protected by the First Amendment.

GPS argues that its demand for underlying and nonpublished raw data, peer review and editor comments, drafts, lab protocols and "all documents and communications," concerning any study of Stephens and Zeng, regarding any GPS product over a more than four year period, is "relevant," notwithstanding that Garner's claims concern only Stephens' and Zengs' published 2021 IIT Study, concerning one GPS product, and not its underlying data, peer review and editor comments, or drafts, much less all documents and communications related to the study or the other categories itemized in GPS' Subpoena Requests. (GPS Brief at 5-6). Significantly, GPS never argues that its Subpoena requests are proportional. GPS also disregards that the *Garner* plaintiffs have not based their claim on *any* non-published documents of Stephens and Zeng as demanded in GPS' Subpoenas. To the extent the *Garner* plaintiffs' claims relate to any document, studies, or testing of Stephens and Zeng, they are limited to the content in the published 2021 IIT Study. (Ex. 4 ¶¶76-80, 82, 138).

GPS disregards that discovery must be "proportional to the needs of the case." *Ribbeck v. Negroni*, No. 19 C 1205, 2021 U.S. Dist. LEXIS 261685, 2021 WL 9553621 (N.D. Ill. March 19,

2021) * 3-4. Where a subpoena is served on non-parties such as Stephens and Zeng, a greater showing is required. Courts are particularly sensitive when weighing the probative value of the information sought against the burden of production on non-parties. *Little v. JB Pritzker for Governor*, No. 18 C 6954, 2020 U.S. Dist. LEXIS 70668, 2020 WL 1039358 (N.D. Ill. April 22, 2020) * 4. Among the factors courts consider are (1) whether the information is relevant; (2) whether the party requesting the information has substantial need for the documents; (3) whether the document requests are overly broad; (4) whether the time period the request covers is reasonable; (5) whether the requests are sufficiently particular; and (6) whether compliance with the requests would impose a burden on the subpoenaed party. *Id.* at *5.

These factors firmly weigh against the enforcement of GPS' Subpoenas. As demonstrated below, to the extent the information sought in the Subpoenas is relevant, it is marginal at best. Moreover, based upon the Complaint and issues in *Garner*, GPS' Subpoena Requests are not proportional and GPS lacks any substantial need for the documents demanded. In addition, the Subpoenas unduly infringe upon Stephens and Zeng's academic freedom. Lastly, because GPS' Motion to Compel is not timely, it should be denied for this independent reason.

A. The Garner Complaint

The *Garner* Complaint alleges that GPS' promotional statements concerning the efficacy of its air ionization products are false and that GPS concealed material facts concerning the quality of its products. (Ex. 4 ¶183). The only count proceeding against GPS is Count I (Deceit and Fraudulent Concealment). The *Garner* plaintiffs allege that GPS knew or should have known of the "defects and misrepresentations of the capabilities and benefits of the Products but failed to disclose these facts prior to or at the time it marketed" them and sold them to consumers. (Ex. 4 ¶183). The Complaint references Stephens' and Zeng's published IIT Study, pertaining to tests

they conducted on one GPS product, in seven of Count One's 190 paragraphs. (Ex. 4 at ¶¶76-80, 82, 138). Stephens' and Zeng's Second IIT Study is not mentioned in the Complaint.

The Complaint also references numerous additional published articles by other authors and scientists which question the efficacy of GPS' products. (Ex. 4 ¶¶89-99, 116-17, 122-131, 133-135, 139). GPS' brief suggests that Garner's overriding issue concerns GPS' misrepresentations that its products eliminate VOCs (GPS Brief at 1-2, 6). However, the Complaint expressly references studies by Boeing and Trane which conclude that contrary to GPS' promotional representations, its products provided only minimal and insignificant reductions in viral inactivation, surface bacteria and no reductions in specific viruses. (Ex. 4 ¶¶91-94). Boeing further found that after testing, GPS' air ionization was "inconclusive" as a methodology for use during the COVID pandemic. (Ex. 4 ¶95). Garner alleges that in purchasing GPS' product he was particularly concerned with its ability to "mitigate the effects of COVID 19 and had read GPS' statements that its products could safely clean the air, *remove* VOCs and effectively attack COVID-19. (Ex. 4 ¶164, 165).

Boeing found that air ionization through GPS' product did not show significant disinfection effectiveness to warrant use on its planes. (Ex. 4, ¶95-96). Similarly, Trane Technologies found that GPS' products had some efficacies for in-air pathogens but *no efficacy* for surface pathogens and VOCs. (Ex. 4 ¶98). Trane found that GPS' tested product was unable to reduce VOCs and "if it cannot reduce VOC's, it cannot supplant outdoor air ventilation, so it cannot conserve energy." (Ex. 4 ¶99). A Professor from Rutgers University further found that GPS' COVID-19 representations were invalid and that its tests were performed in "unmonitored conditions." (Ex. 4 ¶¶122, 124). The Garner plaintiffs further alleged that GPS' stated benchmarks were not replicated

in real world environments, that GPS' testing was not "independent," and that GPS overstated its products' efficacy regarding COVID-19. (Ex. 4 pp.14-15; ¶¶116-120, 135)

Garner does not allege that he relied on the IIT Study. Indeed, he testified that he never saw the IIT Study before his April 24, 2023 deposition (the date of the *Garner* fact discovery cut-off) and was unfamiliar with its content. (Garner Dep. pp. 192-93, GPS Brief, Ex. B). At the deposition, GPS' counsel also referred Garner to the Second IIT Study that Stephens and Zeng subsequently conducted on the same GPS product published on February 1, 2022, and Garner acknowledged that he was not aware of it or its findings. (Garner Dep. p. 200, GPS Brief, Ex. B). Nonetheless, in GPS' Subpoenas to Stephens and Zeng, it demands all documents and communications relating to the Second IIT Study from 2019 through the present, including nonpublic drafts, peer review and editor comments, raw data, lab notes and test protocols. (Exs. 1-2).

GPS suggests that the Second IIT Study superseded and contradicted the IIT Study (GPS Brief at 3, 6). That is a misreading; the Second IIT Study was expressly conducted under different conditions and compared the differences in the results achieved under these other conditions. (GPS Brief, Ex. E at GPSDE ....0809). Although GPS claims that the Second IIT Study found no impact on the concentrations of VOCs through use of GPS' ionizer (GPS Brief at 3), the testing showed that some VOC results increased and some decreased. (GPS Brief, Ex. E at GPSDE ….0814-16). Differences were "minimally quantifiable" but for one increase in the production of VOCs. *Id.* The study concluded, similar to the First IIT Study, that additional studies were needed regarding the product's net impact on chemical compounds on indoor air. *Id.* at …0819.

B. Scheduling Orders and Discovery Cutoffs in the Garner Lawsuit

The Delaware District Court's docket sheet in *Garner* through May 30, 2023 is attached hereto as Exhibit 5. The *Garner* Complaint was filed on May 7, 2021. (Docket No. 1). On April 7, 2022 the court entered a Scheduling Order whereby fact discovery was to close on November 22, 2022 and opening expert reports were due by January 6, 2023. (Docket No. 25). On November 3, 2022 the court extended these deadlines by stipulation whereby fact discovery "will be completed by February 21, 2023 and initial expert disclosures were due on April 6, 2023. (Docket No. 47). On January 17, 2023 the court granted a second stipulated deadline extension whereby fact discovery closed on April 24, 2023 and initial expert disclosures were due June 5, 2023. (Docket No. 49). The court noted in its Order: "The Court will be less willing to grant further extensions." *Id.* Neither party moved to further extend the discovery cut-off after that Order.

C. Service of the GPS Subpoenas on Stephens and Zeng

On April 5, 2023, nearly two years after the *Garner* Complaint was filed, counsel for GPS emailed Phillip Zisook, counsel for Stephens and Zeng concerning GPS' prior non-party subpoenas to them in *GPS v. Zataari* (2021) and *GPS v. Elsevier* (2022) (Exs. 13-14 and 15-16 hereto) and inquired whether Zisook would accept service of subpoenas on their behalf in *Garner*. (Ex. 6). Zisook, who had no prior involvement in *Garner* and previously represented Stephens and Zeng only the two relatively brief *Zataari* and *Elsevier* engagements, responded that he did not have authority at that time, but would let them know if that changed. (Ex.7) Stephens was then served with the GPS Subpoena on April 10, 2023, 14 days prior to the *Garner* fact discovery deadline. On April 13, 2023, Zisook emailed GPS' counsel and advised them that he had been retained to represent Stephens and Zeng with respect to the GPS Subpoenas and that he agreed to

accept service on Zeng's behalf. (See Ex. 8). On April 18, 2023, GPS was served with Stephens' and Zeng's Objections to GPS' Subpoenas. (Ex. 9).

D. The Meet and Confer Conference

On May 3, 2023, nine days after the Garner fact discovery deadline, and two weeks after receipt of Stephens' and Zeng's objections, GPS' counsel requested whether Zisook was available for a Rule 37 meet and confer conference. (Ex. 10). The conference occurred on May 5, 2023 and did not resolve the parties' discovery dispute. In the course of the meet and confer, counsel for GPS confirmed that the *Garner* fact discovery cut-off had passed and that no motion to extend discovery had been filed.

ARGUMENT

I. THE SUBPOENAS ARE OVERBROAD AND NON-PROPORTIONAL

On their faces, the GPS Subpoenas are impermissibly overbroad and non-proportional to the needs of the *Garner* case. Courts and the Federal Rules recognize that non-party status is a significant factor to be considered in determining whether the burden imposed by a subpoena is undue. *Craigville Telephone Co. v. T-Mobile United USA, Inc.*, 2022 U.S. Dist. LEXIS 226705, *3 (N.D. Ill. Dec. 16, 2022); *See*, FRCP Rule 45(d)(1). A non-party subpoena recipient's burden of compliance is a primary factor to be considered both in terms of whether a subpoena is reasonable, and narrowly tailored. *Rossman v. EN Engineering, LLC*, 467 F. Supp.3d 586, 891-92 (N.D. Ill. 2020). ("Under the Federal Rules of Civil Procedure, the unwanted burden thrust upon non-parties is a factor entitled to special weight in evaluating the balance of competing needs. Accordingly, the attorney choosing to issue a subpoena must take reasonable steps to avoid imposing undue burden or expenses on a non-party subject to the subpoena.") See *Little v. JB Pritzker for Governor*, 2020 WL 1939358, at *1 (N.D. Ill. 2020); *HTG Capital Partners, LLC v.*

Doe(s), 2015 WL 5611333 at *3 (N.D. Ill. 2015); *Parker v. Four Seasons Hotels, Ltd.*, 291 F.R.D. 181, 188 (N.D. Ill. 2013).

GPS' Subpoenas seek more than four years' worth of Dr. Stephens' and Ms. Zeng's non-public academic work product, raw data, drafts, lab reports, test protocols, peer review and editor comments, research, and analysis, in addition to "all documents and communications" relating to the IIT Study, the Second IIT Study, "ionization," GPS's products, or "NPBI," and whether GPS' products produce or do not produce byproducts, notwithstanding that Stephens and Zeng are neither parties nor retained experts in *Garner*. GPS' Subpoena Requests go far beyond the single published 2021 IIT Study, pertaining to *one* GPS product, referenced in the *Garner* Complaint. (Ex. 4 ¶¶76-80, 82, 138). Those references do not result in GPS having an unfettered right to obtain through subpoenas every communication and document Stephens and Zeng have regarding GPS and its products.

Neither does GPS have a substantial need for its Subpoena Requests. GPS published its own rebuttal to the IIT Study, "Clearing the Air: The Facts about Recent Studies on Bipolar Ionization" in or about April 2021, which remains posted and publicly accessible at https://gpsair.com/uploads/applications/GPS-NPBI-Facts-Aprilv1.pdf. (Ex. 11 hereto). In its publication, GPS asserts that the published IIT study referenced in the *Garner* Complaint was based on testing methodologies "that were not applicable or incomplete." *Id.* at pp.2-3. GPS delineates eight different bases for that assertion including through testing of the GPS Products at an "independent lab," which purportedly demonstrated that its air ionization products are "safe, efficient and cost-effective." *Id.* Presumably, GPS' expert in *Garner*, given the fact that the case is now in the phase of expert discovery, at the very least, has access to the materials GPS itself had in 2021 to rebut Garner's claim of false GPS' representations and/or the IIT Study.

GPS does not, however, have a substantial need for the wholesale intrusion into Stephens' and Zengs' non-public academic studies, work product, and research, much less "all documents and communications" over a more than 4-year period as demanded in its Subpoenas, particularly when the plaintiffs in *Garner* only refer to their published 2021 IIT Study. Courts properly decline to enforce subpoenas, where the material sought exceeds the scope of the Complaint at issue. See *Craigville Telephone Co. v. T-Mobile United USA, Inc.*, 2022 U.S. Dist. LEXIS 226705 at *7 (N.D. Ill. 2022) ("Certain of Plaintiffs' requests exceed the scope of Plaintiffs' complaint as pled and those requests therefore are not proportional to the needs of this case within the meaning of Federal Rule of Civil Procedure 26(b)(1)").

In order to establish a claim for fraud, Plaintiffs in *Garner* must show that they acted in justifiable reliance on GPS' representations made about its own products, not on "all" of Stephens' and Zengs' non-published data, studies, lab protocols, communications, documents, drafts, and peer review or editor comments relating to GPS or its products which plaintiffs never saw and did not refer to in their Complaint. Indeed, courts commonly strike subpoena language seeking "from a non-party, swaths of information described in superlatives such as 'all communications with … any other third-party referring or relating to [the] Litigation." *Craigville Telephone Co. v. T-Mobile United USA, Inc.*, 2022 U.S. Dist. LEXIS 226705 at *6.

In contrast to the overbreadth of GPS' Subpoenas, the published 2021 IIT Study cited in the *Garner* Complaint, pertains to a single GPS product, the GPS-FC48 AC, and not "all studies, research, analyses, tests, or other investigations of Stephens and Zeng, as demanded in GPS' Subpoenas. (Subpoena Requests 3 and 4, Exs. 1 and 2 herein). Such requests, which "cover too much territory with language requiring [the non-party] to produce 'all documents' that 'refer to or

relate to' a particular topic, or 'all communications'. . . are facially overbroad." *Craigville Telephone Co.* at *6.

The Subpoenas further request "all documents and communications related to the Corrigendum," a less than one-half page published modification to the appendix to Stephens and Zeng's published IIT Study, consisting of one correction and one clarification. (Ex. 1-2, Subpoena Request No. 7. *See also* Ex. 12 hereto). The correction, on is face, expressly remedied an erroneous transposition of titles to two columns in a chart of supplemental data, in an appendix to the IIT Study. Contrary to GPS' implication, the Corrigendum expressly states that the text of the IIT Study itself was accurately identified and labeled. (Ex. 12). The Corrigendum is publicly available and there is no reasonable basis for GPS to pry into immaterial non-public documents and communications over a more than four-year period which were not cited by the *Garner* plaintiffs and which are not proportional to GPS' representations being true or false.

II. THE SUBPOENAS IMPERMISSIBLY CHILL AND INFRINGE UPON ACADEMIC FREEDOM

GPS' Subpoena Requests also demonstrate that they are an unwarranted intrusion upon Stephens' and Zengs' academic freedom, designed to obtain research and work product from non-party/non-designated experts without compensation, or, at worst, to intimidate academics whose research opinions are inconvenient for GPS. Infringement of academic and research freedom is an independent undue burden to a non-party subpoena recipient and violates the First Amendment. See *Dow Chemical v. Allen*, 672 F.2d 1262, 1276 (7th Cir. 1982) (subpoena to non-party academic researchers which would have potentially compelled "virtually every scrap of paper" concerning a study was unduly burdensome and threatened to chill academic freedom).

The Court in *Dow Chemical* found, "academic freedom … has long been viewed as a special concern of the First Amendment." *Id.* at 1274. The Court emphasized, "whatever

constitutional protection is afforded by the First Amendment extends as readily to the scholar in the laboratory as to the teacher in the classroom." *Id.* at 1275. Accordingly, the Court found, "to prevail over academic freedom, the interests of government must be strong and the extent of intrusion carefully limited." *Id.*

Incredibly, the GPS Subpoenas seek the compelled production of proprietary information, studies, research, peer review, lab protocols, drafts, and raw data in addition to "all documents and communications" to secure, without compensation, Stephens' and Zengs' academic work product and thought processes, categories significantly beyond the *Garner* Complaint's narrow references only to their published IIT Study. The *Dow Chemical* Court cautioned:

> (E)nforcement of the subpoenas would leave the researchers with the knowledge throughout continuation of their studies that the fruits of their labors had been appropriated by and were being scrutinized by a not-unbiased third party whose interests were arguably antithetical to theirs. Indeed, it is probably fair to say that the character and extent of intervention would be such that, regardless of its purpose, it would 'inevitably tend to check the ardor and fearlessness of scholars, qualities at once so fragile and so indispensable for fruitful academic labor" (citation omitted). In addition, the researchers could reasonably fear that additional demands for disclosure would be made in the future. If a private corporation can subpoena the entire work product of months of study, what is to say further down the line the company will not seek other subpoenas to determine how the research is coming along? To these factors must be added the knowledge of the researchers that even inadvertent disclosure of the subpoenaed data could jeopardize both the studies and their careers. Clearly enforcement of the subpoenas carries the potential for chilling the exercise of First Amendment rights.

672 F.2d at 1276.

The Court's description of an overbroad subpoena's intrusion and chill on academic freedom is prescient. This is the second time within three years that GPS has attempted to subject both Stephens and Zeng to intrusively overbroad subpoenas in conjunction with their scientific research and testing. In each, Stephens and Zeng were neither parties, nor retained experts. In each, GPS demanded the production of extensive, and non-public academic research, documents,

communications and data. (See, Exs. 13-14, the Subpoenas respectively issued to Stephens and Zeng in *Global Plasma Solutions v. Zataari*, Case no. 3:21-cv-00884-M (N.D. TX 2021) and Ex. 14(a), the *Zataari* Complaint (exhibits omitted). *See also* Exhibits 17 and 18 hereto, Stephens' and Zeng's objections to the *Zataari* subpoenas).

Following receipt of Stephens' and Zengs' objections and multiple Rule 37 conferences in *Zataari*, GPS agreed to substantially narrow the scope of its demands, primarily to communications with the defendants in that case and abandoned its demands for all communications and documents relating to the IIT Study and GPS' products, including raw data, peer review and editor comments, lab protocols, and drafts. (*See* Ex. 19 hereto, correspondence regarding the narrowed scope of GPS' subpoena requests in *Zataari*). Nonetheless, similar overbroad requests are now repeated in GPS' Subpoenas to Stephens and Zeng in *Garner*. *See*, *In re Yasmin & Yaz (Drospirenone) Mktg., Sales Practices & Prods. Liabl. Litig.*, 2011 U.S. Dist. LEXIS 132056 at **8-9 (S.D. Ill. 2011) ("Scientific research in the medical community affects public health and safety. Therefore, damage to the peer review process can also undermine efforts to improve public health and safety. …(T)he court concludes that to disclose the requested peer review comments would be a burden far greater on the academic and scientific community than the probative value to be gained by the defendant so as to render disclosure appropriate").

GPS attempts to distinguish *Dow Chemical*, claiming that the information sought in in that case had little probative value because it was incomplete, whereas here, Garner relies on "Zeng and Stephens' research and studies to claim that GPS' products produce byproducts and GPS's representations to the contrary are false." (GPS Brief p.9) In so arguing, GPS unintentionally demonstrates why its Subpoenas are overbroad and not proportional.

In fact, Garner does not claim *anything* with respect to Stephens' and Zengs "research and studies." His Complaint references only their published 2021 IIT Study, which Garner never saw or read. (Ex. 4 at ¶¶ 76-80, 82, 138; Garner Dep. at 192-93, GPS Brief, Ex. B). He also was not aware of Stephens' and Zeng's Second IIT Study, but GPS demands all communications and documents regarding that Study, notwithstanding that it is not mentioned in the *Garner* Complaint. (Garner Dep. at 200; GPS Brief, Ex. B). The *Garner* Complaint provides no basis to demand production from Stephens and Zeng, of more than four years of non-published communications, documents, and academic studies which "relate to" GPS, NPBI ionization devices, or GPS products. GPS' argument demonstrates that its Subpoena requests are of marginal relevance, if any, and lack proportionality to the *Garner* case.

GPS also attaches emails produced by another non-party in *Garner* which reference that IIT arranged for pre-publication review of the IIT Study prior to its publication. (GPS Brief p. 10). This is a red herring. GPS attempts to cast a negative light on the fact of a pre-publication review of content notwithstanding that GPS has not been hesitant to file lawsuits in response to articles which it feels question the efficacy of its products. (Exs. 13-14, 14(a). *See also* Ex. 4, ¶142 and fn. 137 thereto). Contrary to GPS' argument, that Stephens' and IIT engaged in a pre-publication review process, does not constitute an acknowledgment that the publication of the IIT Study subjected Stephens to a lawsuit, much less a meritorious lawsuit. Further, although GPS for some reason boasts that it "has not sued Stephens, Zeng, or any other author" (GPS Br. at 10), that is simply untrue. Zataari is an author who was sued for defamation by GPS. (Ex. 14(a)). GPS' speculation about the purpose and practice of prepublication review does not change the fact that its Subpoenas to Stephens and Zeng are grossly overbroad and lack proportionality to the needs of the *Garner* case.

III. GPS' MOTION TO COMPEL IS UNTIMELY

GPS' Subpoenas were issued more than two years after the *Garner* Complaint was filed and two and a half weeks before the close of discovery. (Exs. 1-2, Ex. 5, Nos. 1, 49) GPS argues that the Stephens and Zeng materials are necessary to its defense in *Garner*, yet never sought to extend the discovery cut-off that had previously been extended twice. Moreover, GPS never sought the materials at any earlier point in the litigation. Rather, GPS waited until the cusp of the discovery cut-off to even issue subpoenas to Stephens and Zeng and did not request a Rule 37 meet and confer regarding Stephens' and Zengs' objections until after the discovery deadline. (Exs. 1-2, 10) Its Motion to Compel was filed on May 17, 2023, more than three weeks after the discovery cut-off.

Courts have discretion in discovery matters but generally deny motions to compel filed after the close of discovery as being untimely. *Packman v. Chi. Tribune Co.*, 267 F.3d 628 (7th Cir. 2001). This Court recently cited *Packman* in denying a motion to compel, filed less than two weeks prior to the close of discovery. In *Feit Elec. Co. v. CFL Techs. LLC*, No. 13 CV 9339, 2023 U.S. Dist. LEXIS 83685, 2023 WL 3436346 (N.D. Ill. May 12, 2023), the Court recognized that when a motion is filed close to the discovery cut-off date, courts, on occasion, look to the delay in seeking discovery compliance and its reasons as well as what happened during the delay. *Feit Elec. Co.* at *21. The Court found that a delay of four months between the parties meet and confer conference and the filing of the motion to compel was unreasonable and warranted a finding that the motion was untimely notwithstanding that it was filed 13 days before the close of fact discovery. *Id.* at *27. The Court further cited *West v. Miller*, No. 05C4977, 2006 U.S.. Dist. LEXIS 56243, 2006 WL 2349988 at *5-6 (N.D. Ill. Aug. 11, 2006) where a Motion filed 11 days *before* discovery

closed was untimely because it followed "four months of discovery inaction" in the case. *Feit Elec. Co.* at *28.

In this case, GPS issued no discovery to Stephens or Zeng until less than three weeks before the fact discovery deadline, amounting to a delay of one year after the entry of a Scheduling Order on April 7, 2022 (Exhibit 12, No. 25), and a delay of nearly three months after the Delaware District Court's second extension of the discovery cutoff on January 17, 2023, where it noted that it would be "less willing to grant further extensions." (Exhibit 5, No. 49). GPS' inaction continued for months, despite its knowledge that Stephens and Zeng had previously objected to the overbroad GPS subpoenas in the *Zataari* case and would likely continue to object to similar subpoena requests in *Garner*. (Exhibit 17-18). Based upon the totality of the circumstances, GPS' Motion to Compel is untimely and should be denied.

CONCLUSION

For the reasons stated herein, Respondents Brent Stephens and Yicheng Zeng respectfully request that the Motion to Compel of Movant, Global Plasma Solutions, Inc. be denied.

Respectfully submitted,

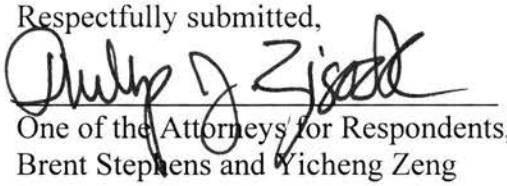

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EXHIBIT 1

AO 88B (Rev. 02/14) Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises in a Civil Action

UNITED STATES DISTRICT COURT

for the

District of Delaware

Robert S. Garner
Plaintiff
v.
Global Plasma Solutions, Inc.
Defendant

Civil Action No. 21-665 (SB)

SUBPOENA TO PRODUCE DOCUMENTS, INFORMATION, OR OBJECTS OR TO PERMIT INSPECTION OF PREMISES IN A CIVIL ACTION

To: Brent Stephens
c/o Phillip J. Zisook, 300 S. Wacker Drive, Suite 1500, Chicago, IL 60606
(Name of person to whom this subpoena is directed)

☑ *Production:* **YOU ARE COMMANDED** to produce at the time, date, and place set forth below the following documents, electronically stored information, or objects, and to permit inspection, copying, testing, or sampling of the material: See Attachment A

Place:	Date and Time:
McGuireWoods LLP 77 West Wacker Drive, Suite 4100 Chicago, IL 60601	04/19/2023 9:00 am

☐ *Inspection of Premises:* **YOU ARE COMMANDED** to permit entry onto the designated premises, land, or other property possessed or controlled by you at the time, date, and location set forth below, so that the requesting party may inspect, measure, survey, photograph, test, or sample the property or any designated object or operation on it.

Place:	Date and Time:

The following provisions of Fed. R. Civ. P. 45 are attached – Rule 45(c), relating to the place of compliance; Rule 45(d), relating to your protection as a person subject to a subpoena; and Rule 45(e) and (g), relating to your duty to respond to this subpoena and the potential consequences of not doing so.

Date: 04/05/2023

CLERK OF COURT

OR

Signature of Clerk or Deputy Clerk

/s/ Robert A. Muckenfuss
Attorney's signature

The name, address, e-mail address, and telephone number of the attorney representing *(name of party)* Global Plasma Solutions, who issues or requests this subpoena, are:

Robert Muckenfuss, 201 N. Tryon St, Ste. 3000, Charlotte, NC 28209; rmuckenfuss@mcguirewoods.com; 704-343-2052

Notice to the person who issues or requests this subpoena

If this subpoena commands the production of documents, electronically stored information, or tangible things or the inspection of premises before trial, a notice and a copy of the subpoena must be served on each party in this case before it is served on the person to whom it is directed. Fed. R. Civ. P. 45(a)(4).

Civil Action No. 21-665 (SB)

PROOF OF SERVICE

(This section should not be filed with the court unless required by Fed. R. Civ. P. 45.)

I received this subpoena for *(name of individual and title, if any)* _____

on *(date)* _____ .

❒ I served the subpoena by delivering a copy to the named person as follows: _____

_____

_____ on *(date)* _____ ; or

❒ I returned the subpoena unexecuted because: _____

_____ .

Unless the subpoena was issued on behalf of the United States, or one of its officers or agents, I have also tendered to the witness the fees for one day's attendance, and the mileage allowed by law, in the amount of $ _____ .

My fees are $ _____ for travel and $ _____ for services, for a total of $ 0.00 .

I declare under penalty of perjury that this information is true.

Date: _____

_____
Server's signature

_____
Printed name and title

_____
Server's address

Additional information regarding attempted service, etc.:

Federal Rule of Civil Procedure 45 (c), (d), (e), and (g) (Effective 12/1/13)

(c) Place of Compliance.

(1) ***For a Trial, Hearing, or Deposition.*** A subpoena may command a person to attend a trial, hearing, or deposition only as follows:

(A) within 100 miles of where the person resides, is employed, or regularly transacts business in person; or

(B) within the state where the person resides, is employed, or regularly transacts business in person, if the person

(i) is a party or a party's officer; or

(ii) is commanded to attend a trial and would not incur substantial expense.

(2) ***For Other Discovery.*** A subpoena may command:

(A) production of documents, electronically stored information, or tangible things at a place within 100 miles of where the person resides, is employed, or regularly transacts business in person; and

(B) inspection of premises at the premises to be inspected.

(d) Protecting a Person Subject to a Subpoena; Enforcement.

(1) ***Avoiding Undue Burden or Expense; Sanctions.*** A party or attorney responsible for issuing and serving a subpoena must take reasonable steps to avoid imposing undue burden or expense on a person subject to the subpoena. The court for the district where compliance is required must enforce this duty and impose an appropriate sanction—which may include lost earnings and reasonable attorney's fees—on a party or attorney who fails to comply.

(2) ***Command to Produce Materials or Permit Inspection.***

(A) *Appearance Not Required.* A person commanded to produce documents, electronically stored information, or tangible things, or to permit the inspection of premises, need not appear in person at the place of production or inspection unless also commanded to appear for a deposition, hearing, or trial.

(B) *Objections.* A person commanded to produce documents or tangible things or to permit inspection may serve on the party or attorney designated in the subpoena a written objection to inspecting, copying, testing, or sampling any or all of the materials or to inspecting the premises—or to producing electronically stored information in the form or forms requested. The objection must be served before the earlier of the time specified for compliance or 14 days after the subpoena is served. If an objection is made, the following rules apply:

(i) At any time, on notice to the commanded person, the serving party may move the court for the district where compliance is required for an order compelling production or inspection.

(ii) These acts may be required only as directed in the order, and the order must protect a person who is neither a party nor a party's officer from significant expense resulting from compliance.

(3) ***Quashing or Modifying a Subpoena.***

(A) *When Required.* On timely motion, the court for the district where compliance is required must quash or modify a subpoena that:

(i) fails to allow a reasonable time to comply;

(ii) requires a person to comply beyond the geographical limits specified in Rule 45(c);

(iii) requires disclosure of privileged or other protected matter, if no exception or waiver applies; or

(iv) subjects a person to undue burden.

(B) *When Permitted.* To protect a person subject to or affected by a subpoena, the court for the district where compliance is required may, on motion, quash or modify the subpoena if it requires:

(i) disclosing a trade secret or other confidential research, development, or commercial information; or

(ii) disclosing an unretained expert's opinion or information that does not describe specific occurrences in dispute and results from the expert's study that was not requested by a party.

(C) *Specifying Conditions as an Alternative.* In the circumstances described in Rule 45(d)(3)(B), the court may, instead of quashing or modifying a subpoena, order appearance or production under specified conditions if the serving party:

(i) shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship; and

(ii) ensures that the subpoenaed person will be reasonably compensated.

(e) Duties in Responding to a Subpoena.

(1) ***Producing Documents or Electronically Stored Information.*** These procedures apply to producing documents or electronically stored information:

(A) *Documents.* A person responding to a subpoena to produce documents must produce them as they are kept in the ordinary course of business or must organize and label them to correspond to the categories in the demand.

(B) *Form for Producing Electronically Stored Information Not Specified.* If a subpoena does not specify a form for producing electronically stored information, the person responding must produce it in a form or forms in which it is ordinarily maintained or in a reasonably usable form or forms.

(C) *Electronically Stored Information Produced in Only One Form.* The person responding need not produce the same electronically stored information in more than one form.

(D) *Inaccessible Electronically Stored Information.* The person responding need not provide discovery of electronically stored information from sources that the person identifies as not reasonably accessible because of undue burden or cost. On motion to compel discovery or for a protective order, the person responding must show that the information is not reasonably accessible because of undue burden or cost. If that showing is made, the court may nonetheless order discovery from such sources if the requesting party shows good cause, considering the limitations of Rule 26(b)(2)(C). The court may specify conditions for the discovery.

(2) ***Claiming Privilege or Protection.***

(A) *Information Withheld.* A person withholding subpoenaed information under a claim that it is privileged or subject to protection as trial-preparation material must:

(i) expressly make the claim; and

(ii) describe the nature of the withheld documents, communications, or tangible things in a manner that, without revealing information itself privileged or protected, will enable the parties to assess the claim.

(B) *Information Produced.* If information produced in response to a subpoena is subject to a claim of privilege or of protection as trial-preparation material, the person making the claim may notify any party that received the information of the claim and the basis for it. After being notified, a party must promptly return, sequester, or destroy the specified information and any copies it has; must not use or disclose the information until the claim is resolved; must take reasonable steps to retrieve the information if the party disclosed it before being notified; and may promptly present the information under seal to the court for the district where compliance is required for a determination of the claim. The person who produced the information must preserve the information until the claim is resolved.

(g) Contempt.

The court for the district where compliance is required—and also, after a motion is transferred, the issuing court—may hold in contempt a person who, having been served, fails without adequate excuse to obey the subpoena or an order related to it.

For access to subpoena materials, see Fed. R. Civ. P. 45(a) Committee Note (2013).

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

ROBERT S. GARNER, on behalf of himself and all others similarly situated, Plaintiff, v. GLOBAL PLASMA SOLUTIONS INC., Defendant.	C.A. No. 21-665 (SB)

ATTACHMENT A TO SUBPOENA
TO PRODUCE DOCUMENTS, INFORMATION, OR OBJECTS IN A CIVIL ACTION

Under Federal Rule of Civil Procedure 45, you are commanded to produce the following documents, electronically stored information, or objects, and to permit inspection, copying, testing, or sampling of the following.

INSTRUCTIONS

1. All words shall be given their ordinary meaning and with the broadest interpretation permitted under the Federal Rules of Civil Procedure so as to encompass the greatest breadth of subject matter, inquiry, and requested response.

2. Requests shall be understood as a whole, and a single word or phrase should not defeat the ordinary meaning and intended purpose of any request. The singular form should be interpreted as the plural, and *vice versa*; and the past, present, and future tenses shall be understood as including but not limited to each other.

3. These Requests are deemed continuing to the fullest extent permissible under Federal Rule of Civil Procedure 26(e) and should be supplemented where required under that Rule.

4. The relevant time period for these requests is March 1, 2019, to present.

DEFINITIONS

1. The terms "**you**" or "**your**" means Brent Stephens and each of his past or present representatives, attorneys, accountants, affiliates, and all other persons or entities acting or purporting to act on behalf of any of the foregoing.

2. The term "**documents**" means all documents and electronically stored information ("ESI") discoverable under the Federal Rules of Civil Procedure.

3. The terms "**communication**" or "**communications**" mean any contact between two or more persons or entities and shall include without limitation, all electronic communications, such as electronic mail, text and other electronic messages, and voicemail, as well as letters, memoranda, or any other documents, and oral contact by such means as face-to-face meetings and telephone conversations.

4. The term "**GPS**" means Defendant Global Plasma Solutions, Inc.

5. The term "**IIT Study**" means the article by Yicheng Zeng and others titled *Evaluating a Commercially Available In-Duct Bipolar Ionization Device for Pollutant Removal and Potential Byproduct Formation*, published in Volume 195 of the journal *Building and Environment* and available online on March 7, 2021 at: https://www.sciencedirect.com/science/article/pii/S036013232100158X.

6. The term "**Second IIT Study**" means the article by Yicheng Zeng and others titled *Evaluation of an In-Duct Bipolar Ionization Device on Particulate Matter and Gas-Phase Constituents in a Large Test Chamber*, published in Volume 213 of the journal *Building and Environment* and available online for purchase on February 1, 2022 at: https://www.sciencedirect.com/science/article/abs/pii/S0360132322001044.

7. The term "**Corrigendum**" means the article by Yicheng Zeng and others titled *Corrigendum to "Evaluating a Commercially Available In-Duct Bipolar Ionization Device for Pollutant Removal and Potential Byproduct Formation"*, published in Volume 214 of the journal *Building and Environment* and available online on February 23, 2022 at: https://www.sciencedirect.com/science/article/pii/S036013232200155X.

8. The term "**NPBI™**" means GPS's needlepoint bipolar ionization technology, as well as all products sold by GPS that incorporate or use that technology.

REQUESTS FOR PRODUCTION UNDER RULE 45

1. All documents and communications relating to the IIT Study, including but not limited to drafts of the IIT Study, comments from peer reviewers or editors, raw data sets, lab notes, and test protocols.

2. All documents and communications relating to the Second IIT Study, including but not limited to drafts of the Second IIT Study, comments from peer reviewers or editors, raw data sets, lab notes, and test protocols.

3. All studies, research, surveys, reviews, analyses, tests, or other investigations that you have conducted or participated in related to ionization, GPS, GPS's products, or NPBI™.

4. All documents and communications related to each study, research, survey, review, analysis, test, or other investigation identified in response to Request No. 3, including but not limited to raw data; draft reports or summaries; lab notes or similar materials; comments from peer reviewers or editors; and documents sufficient to show the testing set-up and other parameters used, including any controls employed.

5. All documents and communications related to the efficacy of GPS's products or NPBI™ against pathogens, viruses, or bacteria.

6. All documents and communications related to the production or nonproduction of byproducts associated with GPS's products or NPBI™.

7. All documents and communications related to the Corrigendum.

EXHIBIT 2

AO 88B (Rev. 02/14) Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises in a Civil Action

UNITED STATES DISTRICT COURT

for the

District of Delaware

Robert S. Garner
Plaintiff
v.
Global Plasma Solutions, Inc.
Defendant

Civil Action No. 21-665 (SB)

SUBPOENA TO PRODUCE DOCUMENTS, INFORMATION, OR OBJECTS OR TO PERMIT INSPECTION OF PREMISES IN A CIVIL ACTION

To: Yicheng Zeng
3001 S Michigan Avenue, Unit 2004, Chicago, Illinois 60616-3163
(Name of person to whom this subpoena is directed)

☑ *Production:* **YOU ARE COMMANDED** to produce at the time, date, and place set forth below the following documents, electronically stored information, or objects, and to permit inspection, copying, testing, or sampling of the material: See Attachment A

Place:	Date and Time:
McGuireWoods LLP 77 West Wacker Drive, Suite 4100 Chicago, IL 60601	04/19/2023 9:00 am

☐ *Inspection of Premises:* **YOU ARE COMMANDED** to permit entry onto the designated premises, land, or other property possessed or controlled by you at the time, date, and location set forth below, so that the requesting party may inspect, measure, survey, photograph, test, or sample the property or any designated object or operation on it.

Place:	Date and Time:

The following provisions of Fed. R. Civ. P. 45 are attached – Rule 45(c), relating to the place of compliance; Rule 45(d), relating to your protection as a person subject to a subpoena; and Rule 45(e) and (g), relating to your duty to respond to this subpoena and the potential consequences of not doing so.

Date: 04/06/2023

CLERK OF COURT

OR

Signature of Clerk or Deputy Clerk

/s/ Robert A. Muckenfuss
Attorney's signature

The name, address, e-mail address, and telephone number of the attorney representing *(name of party)* Global Plasma Solutions, who issues or requests this subpoena, are:

Robert Muckenfuss, 201 N. Tryon St, Ste. 3000, Charlotte, NC 28209; rmuckenfuss@mcguirewoods.com; 704-343-2052

Notice to the person who issues or requests this subpoena

If this subpoena commands the production of documents, electronically stored information, or tangible things or the inspection of premises before trial, a notice and a copy of the subpoena must be served on each party in this case before it is served on the person to whom it is directed. Fed. R. Civ. P. 45(a)(4).

Civil Action No. 21-665 (SB)

PROOF OF SERVICE

(This section should not be filed with the court unless required by Fed. R. Civ. P. 45.)

I received this subpoena for *(name of individual and title, if any)* _____

on *(date)* _____ .

❒ I served the subpoena by delivering a copy to the named person as follows: _____

_____

_____ on *(date)* _____ ; or

❒ I returned the subpoena unexecuted because: _____

_____ .

Unless the subpoena was issued on behalf of the United States, or one of its officers or agents, I have also tendered to the witness the fees for one day's attendance, and the mileage allowed by law, in the amount of $ _____ .

My fees are $ _____ for travel and $ _____ for services, for a total of $ 0.00 .

I declare under penalty of perjury that this information is true.

Date: _____

_____
Server's signature

_____
Printed name and title

_____
Server's address

Additional information regarding attempted service, etc.:

Federal Rule of Civil Procedure 45 (c), (d), (e), and (g) (Effective 12/1/13)

(c) Place of Compliance.

(1) ***For a Trial, Hearing, or Deposition.*** A subpoena may command a person to attend a trial, hearing, or deposition only as follows:

(A) within 100 miles of where the person resides, is employed, or regularly transacts business in person; or

(B) within the state where the person resides, is employed, or regularly transacts business in person, if the person

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(2) ***Claiming Privilege or Protection.***

(A) *Information Withheld.* A person withholding subpoenaed information under a claim that it is privileged or subject to protection as trial-preparation material must:

(i) expressly make the claim; and

(ii) describe the nature of the withheld documents, communications, or tangible things in a manner that, without revealing information itself privileged or protected, will enable the parties to assess the claim.

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(g) Contempt.

The court for the district where compliance is required—and also, after a motion is transferred, the issuing court—may hold in contempt a person who, having been served, fails without adequate excuse to obey the subpoena or an order related to it.

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3. These Requests are deemed continuing to the fullest extent permissible under Federal Rule of Civil Procedure 26(e) and should be supplemented where required under that Rule.

4. The relevant time period for these requests is March 1, 2019, to present.

DEFINITIONS

1. The terms "**you**" or "**your**" means Yicheng Zeng and each of her past or present representatives, attorneys, accountants, affiliates, and all other persons or entities acting or purporting to act on behalf of any of the foregoing.

2. The term "**documents**" means all documents and electronically stored information ("ESI") discoverable under the Federal Rules of Civil Procedure.

3. The terms "**communication**" or "**communications**" mean any contact between two or more persons or entities and shall include without limitation, all electronic communications, such as electronic mail, text and other electronic messages, and voicemail, as well as letters, memoranda, or any other documents, and oral contact by such means as face-to-face meetings and telephone conversations.

4. The term "**GPS**" means Defendant Global Plasma Solutions, Inc.

5. The term "**IIT Study**" means the article by Yicheng Zeng and others titled *Evaluating a Commercially Available In-Duct Bipolar Ionization Device for Pollutant Removal and Potential Byproduct Formation*, published in Volume 195 of the journal *Building and Environment* and available online on March 7, 2021 at: https://www.sciencedirect.com/science/article/pii/S036013232100158X.

6. The term "**Second IIT Study**" means the article by Yicheng Zeng and others titled *Evaluation of an In-Duct Bipolar Ionization Device on Particulate Matter and Gas-Phase Constituents in a Large Test Chamber*, published in Volume 213 of the journal *Building and Environment* and available online for purchase on February 1, 2022 at: https://www.sciencedirect.com/science/article/abs/pii/S0360132322001044.

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8. The term "**NPBI™**" means GPS's needlepoint bipolar ionization technology, as well as all products sold by GPS that incorporate or use that technology.

REQUESTS FOR PRODUCTION UNDER RULE 45

1. All documents and communications relating to the IIT Study, including but not limited to drafts of the IIT Study, comments from peer reviewers or editors, raw data sets, lab notes, and test protocols.

2. All documents and communications relating to the Second IIT Study, including but not limited to drafts of the Second IIT Study, comments from peer reviewers or editors, raw data sets, lab notes, and test protocols.

3. All studies, research, surveys, reviews, analyses, tests, or other investigations that you have conducted or participated in related to ionization, GPS, GPS's products, or NPBI™.

4. All documents and communications related to each study, research, survey, review, analysis, test, or other investigation identified in response to Request No. 3, including but not limited to raw data; draft reports or summaries; lab notes or similar materials; comments from peer reviewers or editors; and documents sufficient to show the testing set-up and other parameters used, including any controls employed.

5. All documents and communications related to the efficacy of GPS's products or NPBI™ against pathogens, viruses, or bacteria.

6. All documents and communications related to the production or nonproduction of byproducts associated with GPS's products or NPBI™.

7. All documents and communications related to the Corrigendum.

EXHIBIT 3

Curriculum Vitae

Brent Stephens, Ph.D.
Professor of Architectural Engineering and Department Chair
Arthur W. Hill Endowed Chair in Sustainability
Department of Civil, Architectural, and Environmental Engineering
Illinois Institute of Technology
3201 South Dearborn Street
Alumni Memorial Hall 228E
Chicago, IL 60616
Phone: (312) 567-3629
Email: brent@iit.edu

Director, Built Environment Research Group
Web: http://www.built-envi.com
Twitter: @built_envi

May 2023

Table of Contents

1 Curriculum Vitae

1.1 Demographic information

Name:	Brent Stephens, Ph.D.
Title:	Professor, Department Chair, and Arthur W. Hill Endowed Chair in Sustainability
Department:	Department of Civil, Architectural, and Environmental Engineering
Program(s):	Architectural Engineering and Environmental Engineering
Campus address:	Illinois Institute of Technology 3201 S Dearborn Street Alumni Memorial Hall Room 228E Chicago, IL 60616 Office: (312) 567-3629 E-mail: brent@iit.edu Research group website: http://built-envi.com

1.2 Education

Doctor of Philosophy:	University of Texas at Austin
Program:	Civil Engineering
Date:	May 2012
Dissertation title:	"Characterizing the impacts of air-conditioning systems, filters, and building envelopes on exposures to indoor pollutants and energy consumption in residential and light-commercial buildings"
Honors:	Thrust 2000 Endowed Fellowship (2007-2011) National Science Foundation IGERT Trainee Fellowship (2009-2011) Graduate School Continuing Fellowship (2011-2012)
Master of Science:	University of Texas at Austin
Program:	Environmental and Water Resources Engineering
Date:	May 2009
Thesis title:	"Energy implications of filters in residential and light-commercial HVAC systems"
Honors:	Thrust 2000 Endowed Fellowship (2007-2011) ASHRAE Graduate Student Grant-in-Aid (2008)
Bachelor of Science:	Tennessee Technological University
Program:	Civil Engineering
Date:	May 2007
Honors:	University Service Scholarship (2002-2006) Asia Khatun Endowment Scholarship (2005) J.R. Wauford Scholarship (2006)

1.3 Professional history

Time period:	August 2012 – Present
Titles:	Arthur W. Hill Endowed Chair in Sustainability (2022-present) Professor (2020-present) Department Chair (2018-present) Associate Professor (2016-2020) Assistant Professor (2012-2016)
Institution:	Illinois Institute of Technology (IIT)
Department:	Department of Civil, Architectural and Environmental Engineering (CAEE)
Programs:	Architectural Engineering (ARCE), Environmental Engineering (ENVE)
Responsibilities:	Responsibilities in this position, excluding Chair duties, include: building an externally funded research group; serving as principal investigator on externally funded research projects; supervising and mentoring postdoctoral, graduate, and undergraduate researchers; teaching undergraduate and graduate courses in civil, architectural, and environmental engineering; advising undergraduate and graduate students; developing and writing research proposals; writing and editing manuscripts for publication in peer-reviewed journals; presenting research results at national and international conferences, universities, national laboratories, and other industry, academic, and professional communities; serving as a peer reviewer for journals, conferences, and proposal panels; serving on department and university committees; and networking within Chicago and beyond to further research and education in CAEE at IIT.
Time period:	August 2007 – May 2012
Title:	Graduate Research Assistant
Institution:	University of Texas at Austin
Department:	Department of Civil, Architectural and Environmental Engineering
Responsibilities:	Responsibilities in this position included conducting research on energy and indoor air quality in buildings. Ph.D. adviser: Dr. Jeffrey A. Siegel.

1.4 Contributions to teaching

1.4.1 Courses taught

I have taught the following courses at Illinois Tech:

- CAE 331/513 Building Science
- CAE 463/524 Building Enclosure Design
- ENVE 576 Indoor Air Pollution
- CAE 553 Measurements and Instrumentation in Architectural Engineering
- CAE 110 and CAE 111 Introduction to the Profession

1.4.2 Teaching evaluations

Results from course evaluations for courses that I've (a) taught individually and (b) co-taught are provided below. In the courses I've taught individually, I have had an average enrollment of approximately 27 students and received an average instructor rating of **4.73** and a mean course rating of **4.57** out of 5.0. Both are considerably higher than the IIT average of ~4.25 and ~4.15 since I started in 2012. I was acknowledged as an *Exceptional Professor* by the IIT chapter of the American Society of Civil Engineers (ASCE) in 2016 and awarded the *Outstanding Professor Award* as the best professor in the CAEE Department from ASCE-IIT in 2019.

(a) Individually taught course evaluations

Course No.	Course Name	Term	Enrollment	Mean Instructor Rating	Mean Course Rating
CAE 463/524	Building Enclosure Design	Fall 2012	21	4.81	4.62
		Fall 2013	13	4.86	4.86
		Spring 2014	13	4.67	4.67
		Spring 2015	19	4.73	4.80
		Spring 2016	20	4.71	4.43
		Spring 2018	13	4.67	5.00
CAE 331/513	Building Science	Fall 2013	30	4.45	4.09
		Fall 2014	40	3.79	3.62
		Fall 2015	21	4.70	4.80
		Fall 2016	15	4.44	4.56
		Fall 2017	35	4.62	4.23
		Fall 2018	33	4.85	4.20
		Fall 2019	21	4.83	4.50
		Fall 2020	31	5.00	5.00
		Fall 2021	31	5.00	4.60
		Fall 2022	29	4.82	4.91
ENVE 576	Indoor Air Pollution	Spring 2013	9	5.00	4.57
		Fall 2014	17	4.94	4.94
		Fall 2015	18	5.00	4.92
		Fall 2016	13	5.00	5.00
		Fall 2017	13	5.00	4.80
CAE 553	Measurements in ARCE	Fall 2018	10	5.00	4.85
CAE 110	Intro to the Profession I	Fall 2018	48	4.50	3.80
		Fall 2019	50	4.67	4.38
		Fall 2020	47	4.92	4.54
		Fall 2021	36	4.73	4.64
		Fall 2022	44	4.43	4.21
CAE 111	Intro to the Profession II	Spring 2020	47	4.70	4.05
		Spring 2021	42	4.77	4.46
		Spring 2022	31	5.00	5.00
		Mean	**26.7**	**4.73**	**4.57**

Notes: I was on parental leave in Spring 2017 and did not teach any courses. In Fall 2018, my required teaching load was reduced to 1 course per year as Department Chair, although I have tended to exceed that requirement by teaching CAE 110/111 Introduction to the Profession in addition to CAE 331/513 Building Science. Also, in Fall 2018 and Spring 2019, IIT switched to a new student evaluation system; scores from that system are converted from a 0-100% basis to a 0-to-5-point basis for consistency (the system was later changed back to a 5-point scale).

(b) Co-taught course evaluations

Course	Term	Enroll-ment	Mean Instructor Rating	Mean Course Rating	Lead Instructor
CAE 110 Intro to the Profession I	Fall 2017	33	4.50	3.90	Anderson
CAE 111 Intro to the Profession II	Spring 2018	27	4.00	4.33	Anderson
CAE 553 Measurements in Arch Eng.	Spring 2018	7	5.00	5.00	Heidarinejad
CAE 111 Intro to the Profession II	Spring 2019	42	3.75	4.20	Stephens

1.4.3 Mentoring and supervision of researchers

Summarized below are both current and former undergraduate, graduate, and postdoctoral researchers for whom I have served as primary or, where noted, secondary research advisor/mentor.

1.4.3.1 Postdoctoral researcher supervisions

Researcher	Degree	Years	Research topic
Stephanie Kunkel[1]	Postdoc	2014-2016	Bioaerosol fate, transport and control
Parham Azimi[2]	Postdoc	2016-2018	Ventilation, IAQ, and asthma (HUD)
Akram Ali[3]	Postdoc	2021-2022	Steam trap sensing and alarm
Insung Kang[3]	Postdoc	2023-	Air cleaners for COPD in veterans

[1]Microbiology of the Built Environment Postdoctoral Fellowship, Alfred P. Sloan Foundation; currently a Senior Scientist at Abbott Labs
[2]Currently a Research Associate at the Harvard T.H. Chan School of Public Health
[3]Co-mentored by Mohammad Heidarinejad

1.4.3.2 Ph.D. supervisions in progress

Student	Degree	Program	Years	Dissertation topic
Yicheng Zeng	Ph.D.	ENVE	2018-	Energy implications of improving indoor air quality
Mingyu Wang	Ph.D.	ARCE	2020-	Residential pollutant sources: indoor vs. outdoor contributions
Minyoung Kim	Ph.D.	ARCE	2021-	TBD

1.4.3.3 Ph.D. supervisions completed

Student	Degree	Program	Years	Dissertation topic
Parham Azimi[1,2,3]	Ph.D.	ENVE	2013-2016	Advances in indoor aerosols
Tommy Zakrzewski[4]	Ph.D.	CE (PT)	2012-2017	District energy system design tools
Haoran Zhao[1,5]	Ph.D.	ENVE	2014-2018	Outdoor pollutant infiltration
Torkan Fazli[1]	Ph.D.	ARCE	2014-2020	Climate change, indoor air, health
Dan Zhao	Ph.D.	ENVE	2014-2020	Mold growth on building materials
Akram Ali[6] (PT[7])	Ph.D.	ARCE	2015-2021	Open-source building sensors
Insung Kang[8,9]	Ph.D.	ARCE	2018-2022	Residential ventilation, IAQ, asthma
Lobna Mitkees	Ph.D.	ARCH	2018-2022	Personal comfort systems for historical buildings

[1]Received ASHRAE Graduate Student Grant-In-Aid Award ($10,000 scholarship)
[2]Received ASHRAE Homer Addams Award for his involvement in ASHRAE Research Project RP-1691 ($5,000 award in 2017)
[3]Currently a postdoctoral researcher at the Harvard T.H. Chan School of Public Health
[4]Received Association of Energy Engineers Foundation (FAEE) William "Bill" Maschburn Scholarship twice: $2,000 scholarship in both 2015 and 2016. Currently a Vice President at HKS, Inc.
[5]Currently a postdoctoral researcher at Lawrence Berkeley National Laboratory (LBNL)
[6]Co-advised by Dr. Mohammad Heidarinejad; currently a postdoctoral researcher at IIT
[7]PT = part-time for a portion of PhD studies
[8]Won the 2022 Sigma Xi/IIT Award for Excellence in Research ($500)
[9]Won a 2022 Korean-American Scientists and Engineers Association (KSEA) / Korea - U.S. Science Co-operation Center (KUSCO) Graduate Scholarship ($2,000)

1.4.3.4 M.S. supervisions in progress

Student	Degree	Program	Years	Thesis topic
Chris Riley[1]	M.S.	ARCE	2018-23	Novel radiator control system

[1]Co-advised by Dr. Mohammad Heidarinejad

1.4.3.5 M.S. supervisions completed

Student	Degree	Program	Graduated	Thesis topic
Zeineb El Orch	M.S.	CAE	2013	Modeling the infiltration of outdoor particulate matter
Maria G. Soriano[1]	M.S.	CAE	2013	On-site wind and PV design for O'Hare International Airport
Tiffanie Ramos[2]	M.S.	ENVE	2014	Building science measurements in the Hospital Microbiome Project
Honnie Leinartas	M.S.	CAE	2014	Prioritizing Chicagoland housing retrofits for 50% energy savings
Akram Ali	M.S.	ARCE	2015	Open-source building science sensors
Yicheng Zeng	M.S.	ENVE	2018	In-situ HVAC filter testing
Brett Horin[3]	M.S.	ARCE	2018	CFD and predictive models for natural ventilation controls
Kari Abromitis	M.S.	ARCE	2020	Ventilation systems, IAQ, and asthma
Chris Bradley	M.S.	ENVE	2021	Using low-cost VOC sensor data to estimate air change rates in homes
Mingyu Wang	M.S.	ARCE	2021	Ambient PM infiltration in homes before and after ventilation retrofits

[1]Co-advised by Dr. Jamshid Mohammadi; [2]Starr/Fieldhouse Fellowship winner, 2013; [3]Co-advised by Dr. Mohammad Heidarinejad

1.4.3.6 Special project supervisions completed

Student	Degree	Program	Year	CAE or ENVE 497/597 topic
Alex Ballester	M.E.	ARCE	2013	597: Building energy simulation
Alvaro Gonzalez	M.E.	ARCE	2013	597: Building energy simulation
Janis Hubert	M.E.	ARCE	2014	597: Building energy simulation
June Young Park	B.S.	ARCE	2014	497: DOE student design challenge

Andi Mele	M.E.	ARCE	2015	597: Thermal bridging of enclosures
Elizbeth Mullin	B.S./M.E.	ARCE	2015	497: Fire alarms in MSV
Saeid Khodaei	M.E.	ARCE	2015	597: Air filtration for cookstoves
Han Jiang	M.E.	ENVE	2016	597: Microenvironmental NO_x
Jiayáo Xu	M.E.	ENVE	2016	597: Microenvironmental NO_x
Lindsey Rice	B.S./M.E.	ARCE	2017	597: OpenStudio energy modeling
Mehdi Ashayeri	Ph.D.	ARCH	2017	597: Double skin façade evaluation
Andoni Ramos	M.E.	ARCE	2017	597: Energy efficiency trade-offs
Zhihui Shao	M.E.	ENVE	2017	597: I/O pollutant modeling
Dan Zhao	Ph.D.	ENVE	2017	597: Microbial growth on materials
Haoran Zhao	Ph.D.	ENVE	2017	597: Outdoor pollutant transport
Khadijah Nesbitt	B.S.	ARCE	2017/18	497: Arch. Eng. lab improvement
Emily Barnett	B.S./M.E.	ARCE	2017	597: Arch. Eng. lab improvement
Michael Desch	B.S./M.E.	ARCE	2017/18	597: Arch. Eng. lab improvement
Larry Dorn	M.E.	CEM	2017/18	597: Arch. Eng. lab improvement
Stephen Foss	M.E.	ARCE	2017	597: Building enclosure details
Jaime Marin	M.E.	MMAE	2018	597: Building energy modeling
Sneha Mahadev	M.E.	CEM	2018	597: Building energy modeling
Anna Mounier	M.E.	ARCE	2018	597: Campus energy models
Esther Rodriguez	M.E.	MMAE	2018	597: Bottom-up LEED approach
Sean Killarney	M.E.	ARCE	2018	597: Building hands-on HVAC lab
Ajay Kotur	M.E.	ARCE	2018	597: Building hands-on HVAC lab
Roger Fortune	M.E.	ARCE	2019	597: Historical building retrofits
Keonho Li	M.E.	ARCE	2019	597: DSF energy/CFD simulation
Lobna Mitkees	Ph.D.	ARCH	2019	597: Thermal comfort, Crown Hall
Gurmandeep Saggu	M.E.	ARCE	2019	597: Hands-on HVAC lab
Erica Acton	M.E.	ARCE	2020	597: Radiator comfort assessment
Isabel Arguello	M.E.	ARCE	2020	597: Radiator controller software
Haonan Sun	M.E.	CEM	2021	597: Infectious disease transmission
Mingyu Wang	M.S.	ARCE	2021	597: PM infiltration algorithms

1.4.3.7 Other graduate defense, comprehensive committees, and undergraduate mentoring

I have served as a secondary or external committee member (and at times, de facto primary research advisor) for the following thesis and dissertation committees:
*Students/researchers marked with an asterisk have been co-authors on peer-reviewed journal articles.

1. Irina Susorova, Ph.D., College of Architecture, IIT, 2013*
   - Primary adviser: Mahjoub Elnimeiri, College of Architecture, IIT
   - Thesis topic: "Assessing the thermal performance of vegetative facades"
2. Abraham Kruger, M.S., Building Construction, College of Architecture, Georgia Institute of Technology, 2013
   - Primary adviser: Javier Irizarry, Georgia Institute of Technology
   - Thesis topic: "The impact of filter loading on residential HVAC systems"
3. Karen Dannemiller, Ph.D., Environmental Engineering, Yale University, 2014
   - Primary adviser: Jordan Peccia, Yale University
   - Dissertation topic: "Integrating measurements of environmental fungal communities with human health outcomes"
4. Se Yen Lai, M.S., Civil Engineering, IIT, 2014
   - Primary adviser: Ralph Muehleisen, Argonne National Laboratory

- Thesis topic: "A parametric study of the thermal performance of different wall systems at various climate zones"

5. Aysan Khorraminejad, Ph.D., College of Architecture, IIT, 2014
   - Primary adviser: Matthew Herman, College of Architecture, IIT
   - Thesis topic: "Natural ventilation using a solar chimney and phase change materials"
6. Peng Du, Ph.D., College of Architecture, IIT, 2015*
   - Primary adviser: Antony Wood, College of Architecture, IIT, and the Council on Tall Buildings and Urban Habitat (CTBUH)
   - Dissertation topic: "Sustainability implications of downtown high-rise vs. suburban low-rise living"
7. Gilberto Osornio Nieto, Ph.D., College of Architecture, IIT, 2018
   - Primary adviser: Matthew Herman, College of Architecture, IIT
   - Dissertation topic: "Integrating radiant cooling systems with natural ventilation in predominantly glazed facades in hot and warm climates"
8. Andres Pinzon Latorre, Ph.D., College of Architecture, IIT, 2017
   - Primary adviser: Peter Land, College of Architecture, IIT
   - Dissertation topic: "Thermal comfort of low-income patio houses in Colombia"
9. Chunyi Wang, Ph.D., Drexel University, 2019
   - Primary adviser: Michael Waring, Drexel University
   - Dissertation topic: "Secondary organic aerosol formation indoors: Experimental and modeling investigations of impacts of surface reactions and equilibrium partitioning processes"
10. Narjes Abbasabadi, Ph.D., College of Architecture, IIT, 2019*
    - Primary adviser: Rahman Azari, College of Architecture, IIT
    - Dissertation topic: "An integrated data-driven framework for urban energy use modeling"
11. Mehdi Ashayeri, Ph.D., College of Architecture, IIT, 2020*
    - Primary adviser: Rahman Azari, College of Architecture, IIT
    - Dissertation topic: "A framework for urban resilience"
12. Afshin Faramarzi, Ph.D., Civil Engineering, IIT, 2021*
    - Primary advisor: Mohammad Heidarinejad, CAEE, IIT
    - Dissertation topic: "Developing novel optimization algorithms applied to building energy performance and indoor air quality" (Received ASHRAE Graduate Student Grant-In-Aid Award, as $10,000 scholarship)
13. Sheng Wang, Ph.D., Drexel University, 2021
    - Primary adviser: James Lo, Drexel University
    - Dissertation topic: "Method of quantifying wind-driven natural ventilation flowrate and the development of systematic analysis on the relationship between the flowrate and building configuration"
14. Zahida Khan, Ph.D., College of Architecture, IIT, ongoing
    - Primary adviser: myself and Mohammad Heidarinejad
    - Dissertation topic: "Human spatial behavior and microclimates"

I have served as an undergraduate research adviser in the ACE PURE/MIND programs for the following students:

1. Dina Curioni, CAEE, 2014, Building science performance assessment in Carman Hall
2. Deion Debose, CAEE, 2013-2015*, Open source building science sensors
3. Laurit Dide, CAEE, 2013, Hospital Microbiome Project
4. Boyang "Bobo" Dong, ECE, 2014, Open source building science sensors
5. Utsav Gandhi, ChBE, 2013, Indoor air quality in developing countries
6. Sara Glade, CAEE, 2013, Emissions of ultrafine particles from desktop 3D printers
7. Hailey Kunkel, CAEE, 2013, Energy and life cycle cost impacts of duct designs in homes
8. Roxanne Myers, CAEE, 2013, Development of a hot box thermal testing facility

9. Matthew Thomas, CAEE, 2013, Developing of an in-situ filter performance testing facility
10. Nina Townley, CAEE 2013-2014, Building science performance assessment in Carman Hall
11. Benjamin Waccholz, CAEE, 2013, Developing a system to measure outdoor pollutant infiltration
12. Rou Yi Yeap, ChBE, 2014*, Energy implications of high pressure elements in residential HVAC
13. Zachary Zanzinger, CAEE, 2014, Open source building science sensors
14. Jihad Zeid, ChBE, 2014-2015, Measuring outdoor pollutant transport into an apartment unit
15. C.W. (Chris) Riley, MMAE, 2017-2018*, Developing an automated shading system for glazing units and automatic radiator controls
16. Erica Acton, CAEE, 2019*, (co-advised by Dr. Mohammad Heidarinejad), Energy savings for radiators using building sensors and controls
17. Urwa Irfan, CAEE, 2020, (co-advised by Dr. Mohammad Heidarinejad), Energy savings for radiators using building sensors and controls

I have served as research adviser to one undergraduate student from the IIT-Paris program:

1. Claire Pouzet, 2015, EVIP*, Ultrafine particle and VOC emissions from desktop 3D printers

I have served as research adviser to one high school student from the Illinois Math and Science Academy:

1. Mylee Rolock, 2014 and 2015, IMSA, Open source sensors and indoor air quality modeling
2. Nitya Jakka, 2022-2023, IMSA, Applications of low-cost indoor CO_2 monitors

1.5 Publications

My citation statistics* from Google Scholar are as follows:

- 7983 citations
- h-index: 36
- i10-index: 69

*Data current as of May 30, 2023

1.5.1 Papers published in peer-reviewed journals

1. Kang, I., McCreery, A., Azimi, P., Gramigna, A., Baca, G., Abromitis, K., Wang, M., Zeng, Y., Scheu, R., Crowder, T., Evens, A., **Stephens, B.** Impacts of residential indoor air quality and environmental risk factors on adult asthma-related health outcomes in Chicago, IL. Accepted to *Journal of Exposure Science and Environmental Epidemiology* November 2022.
2. Zeng, Y., Laguerre, A., Gall, E., Heidarinejad, M., **Stephens, B.** 2022. Experimental evaluations of the impact of an additive oxidizing air cleaner on particles and gases. *Pollutants* 2(2):98-134 (Special Issue on Pollutants in Indoor Air).
3. Zeng, Y., Heidarinejad, M., **Stephens, B.** 2022. Evaluation of an in-duct bipolar ionization device on particulate matter and gas-phase constituents in a large test chamber. *Building and Environment* 213:108858.
4. Kang, I., McCreery, A., Azimi, P., Gramigna, A., Baca, G., Abromitis, K., Wang, M., Zeng, Y., Scheu, R., Crowder, T., Evens, A., **Stephens, B.** 2021. Indoor air quality impacts of residential mechanical ventilation system retrofits in existing homes in Chicago, IL. *Science of the Total Environment* 804:150129.
5. Breen, M., Isakov, V., Prince, S., McGuinness, K., Egeghy, P., **Stephens, B.**, Arunachalam, S., Stout, D., Walker, W., Alston, L., Rooney, A., Taylor, K., Buckley, T. 2021. Integrating personal air sensor and GPS to determine microenvironment-specific exposures to volatile organic compounds. *Sensors* 21(16):5659.
6. Ali, A., Riley, C., Acton, E., Ali, A., Heidarinejad, M., **Stephens, B.** 2021. Development and evaluation of an automatic steam radiator control system for retrofitting legacy heating systems in existing buildings. *Energy and Buildings* 251:111344.

7. Zeng, Y., Yu, H., Zhao, H., **Stephens, B.**, Verma, V. 2021. Influence of environmental conditions on the dithiothreitol (DTT)-based oxidative potential of size-resolved indoor particulate matter of ambient origin. *Atmospheric Environment* 255:118429.
8. Zeng, Y., Manwatkar, P., Laguerre, A., Beke, M., Kang, I., Ali, A., Farmer, D., Gall, E., Heidarinejad, M., **Stephens, B.** 2021. Evaluating a commercially available in-duct bipolar ionization device for pollutant removal and potential byproduct formation. *Building and Environment* 195:107750.
9. Fazli, T., Dong, X., Fu, J., **Stephens, B.** 2021. Predicting U.S. residential building energy use and indoor pollutant exposures in the mid-21st century. *Environmental Science and Technology* 55(5):3219-3228.
10. Faramarzi, A., **Stephens, B.**, Heidarinejad, M. 2021. Optimal control of a switchable ethylene-tetrafluoroethylene (ETFE) cushion for building facades. *Solar Energy* 218:180-194.
11. Azimi, P., Keshavarz, Z., Cedeno Laurent, J.G., **Stephens, B.**, Allen, J.G. 2021. Mechanistic transmission modeling of COVID-19 on the Diamond Princess Cruise Ship demonstrates the importance of aerosol transmission. *Proceedings of the National Academy of Sciences* 118(8):e2015482118.
12. Reddy, M., Heidarinejad, M., **Stephens, B.**, Rubinstein, I. 2020. Adequate indoor air quality in nursing homes: an unmet medical need. *Science of the Total Environment* 765:144273 (Commentary).
13. Ashayeri, M., Abbasabadi, N., Heidarinejad, M., **Stephens, B.** 2021. Predicting intraurban $PM_{2.5}$ concentrations based on human activity patterns and enhanced machine learning approaches. Accepted to *Environmental Research* 196:110423.
14. Zhao, D., Raba, D., Cardona, C., Gottel, N., Winton, V., Thomas, P., Kelley, S., Gilbert, J., **Stephens, B.** 2020. The influence of material chemical composition on microbial dynamics of wetted building materials. *Scientific Reports* 10:14500.
15. Xu, Y., Tandon, R., Ancheta, C., Arroyo, P., Gilbert, J.A., **Stephens, B.**, Kelley S.T. 2020. Quantitative profiling of built environment bacterial and fungal communities reveals dynamic material dependent growth patterns and microbial interactions. *Indoor Air* 31(1):188-205.
16. Faramarzi, A., **Stephens, B.**, Heidarinejad, M. 2020. Assessing ventilation control strategies in underground parking garages. *Building Simulation* 14:701-720.
17. Faramarzi, A., Heidarinejad, M., **Stephens, B.**, Mirjalili, S. 2020. Equilibrium Optimizer: A Novel Optimization Algorithm. *Knowledge-Based Systems* 191:105190.
18. Ali, A., Coté, C., Heidarinejad, M., **Stephens, B.** 2019. *Elemental*: An open-source wireless hardware and software platform for building energy and indoor environmental monitoring and control. *Sensors* 19(18). DOI:10.3390/s19184017.
19. Susorova, I., **Stephens, B.**, Skelton, B. 2019. The effect of balcony thermal breaks on building thermal and energy performance: field experiments and energy simulations in Chicago, IL. *Buildings*, 9(9):190. DOI:10.3390/buildings9090190.
20. **Stephens, B.**, Azimi, P., Thoemmes, M.S., Heidarinejad, M., Allen, J.G., Gilbert, J.A. 2019. Microbial exchange via fomites and implications for human health. *Current Pollution Reports* 5:198-213.
21. Yim, S.H.L., Gu, Y., Shapiro, M., **Stephens, B.** Air quality and acid deposition impacts of local emissions and transboundary air pollution in Japan and South Korea. Accepted to *Atmospheric Chemistry and Physics: Discussions*. DOI:10.5194/acp-2019-175.
22. Zhao, H., Gall, E.T., **Stephens, B.** 2019. Measuring the penetration factor for ambient nitrogen oxides through the building envelope. *Environmental Science and Technology* 53(16):9695-9704.
23. Abbasabadi, N., Azari, R., Ashayeri, M., **Stephens, B.**, Heidarinejad, M. 2019. An integrated data-driven framework for urban energy use modeling (UEUM). *Applied Energy*, 243:113550.
24. Fazli, T., Zeng, Y., **Stephens, B.** 2019. Fine and ultrafine particle removal efficiency of new residential HVAC filters. *Indoor Air* 29(4):656-669.
25. Chin, K., Laguerre, A., Ramasubramanian P., Pleshakov, D., **Stephens, B.**, Gall, E.T. Primary emissions, ozone reactivity, and byproduct emissions from building insulation materials.

Accepted in *Environmental Science: Process & Impacts* (Special Issue on Indoor Chemistry). DOI: 10.1039/C9EM00024K.

26. Lax, S., Cardona, C., Zhao, D., Winton, V.J., Goodney, G., Gao, P., Gottel, N., Hartmann, E., Henry, C., Thomas, P.M., Kelley, S.T., **Stephens, B.**, Gilbert, J.A. 2019. Microbial and metabolic succession on common building materials under high humidity conditions. *Nature Communications*, 10:1767.
27. Azimi, P, **Stephens, B.** 2018. A framework for estimating the US mortality burden of fine particulate matter exposure attributable to indoor and outdoor microenvironments. *Journal of Exposure Science and Environmental Epidemiology* 30:271-284.
28. Gilbert, J.A., **Stephens, B.** 2018. Microbiology of the built environment. *Nature Reviews Microbiology* 16:661-670.
29. Azimi, P., Zhao, H., Fazli, T., Zhao, D., Faramarzi, A., Leung, L., **Stephens, B.** 2018. Pilot study of the vertical variations in outdoor pollutant concentrations and environmental conditions along the height of a tall building. *Building and Environment* 138:124-134.
30. Cardona, C., Lax, S., Larsen, P., **Stephens, B.**, Hampton-Marcell, J., Edwardson, C., Henry, C., Van Bonn, B., Gilbert, J.A. 2018. Environmental sources of bacteria differentially influence host-associated microbial dynamics. *mSystems* 3(3):e00052-18.
31. Fazli, T., **Stephens, B.** 2018. Development of a nationally representative set of combined building energy and indoor air quality models for U.S. residences. *Building and Environment* 136:192-212.
32. **Stephens, B.** 2018. Evaluating the sensitivity of the mass-based particle removal calculations for HVAC filters in ISO 16890 to assumptions for aerosol distributions. *Atmosphere* 9(3):85.
33. Thompson et al., and The Earth Microbiome Project Consortium (**Stephens, B.**, member). 2017. A communal catalogue reveals Earth's multiscale microbial diversity. *Nature* 551:457-463.
34. Du, P., Wood, A., Ditchman, N., **Stephens, B.** 2017. Life satisfaction of downtown high-rise vs. suburban low-rise living: A Chicago case study. *Sustainability* 9(6):1052.
35. Xu, J., Jiang, H., Zhao, H., **Stephens, B.** 2017. Mobile monitoring of personal NO_x exposures during scripted daily activities in Chicago, IL. 2017. *Aerosol and Air Quality Research* 17(8):1999-2009.
36. Lax, S., Sangwan, N., Smith, D., Larsen, P., Handley, K., Richardson, M., Landon, E., Siegel, J.A., Alverdy, J., Knight, R., **Stephens, B.**, Gilbert, J.A. 2017. Bacterial colonization and succession in a newly opened hospital. *Science Translational Medicine* 9(391):eaah6500.
37. Kunkel, S., Azimi, P., Zhao, H., Stark, B. **Stephens, B.** 2017. Quantifying the size-resolved dynamics of indoor bioaerosol transport and control. *Indoor Air* 27(5):977-987.
38. Zhao, H., **Stephens, B.** 2017. Using portable particle sizing instrumentation to measure the penetration of fine and ultrafine particles through residential building enclosures. *Indoor Air* 27(1):218-229.
39. Zakrzewski, T., **Stephens, B.** 2017. Generalized natural gas reciprocating engine part-load performance curves for cogeneration applications. *Science and Technology for the Built Environment* 23(7):1151-1158.
40. Azimi, P., Fazli, T., **Stephens, B.** 2017. Predicting concentrations of ultrafine particles and volatile organic compounds resulting from desktop 3D printer operation in a small office environment and the impact of potential control strategies. *Journal of Industrial Ecology* 21(S1):S107-S119.
41. Bibby, K., Adams, R.I., Bhangar, S., Dannemiller, K., Eisen, J., Fierer, N., Gilbert, J.A., Green, J.A., Marr, L., Miller, S.L., Siegel, J.A., **Stephens, B.**, Waring, M.S. 2016. Ten questions concerning the microbiomes of buildings. *Building and Environment* 109:224-234.
42. **Stephens, B.** 2016. What have we learned about the microbiomes of indoor environments? *mSystems* 1(4):e00083-16. (Mini-review)
43. Du, P., Wood, A., **Stephens, B.** 2016. Empirical operational energy analysis of downtown high-rise vs. suburban low-rise lifestyles: A Chicago case study. *Energies* 9(6):445.
44. Ali, A., Zanzinger, Z., Debose, D., **Stephens, B.** 2016. Open source building science sensors (OSBSS): A low-cost Arduino-based platform for long-term data collection in indoor environments. *Building and Environment* 100:114-126.

45. Azimi, P., Zhao, D., **Stephens, B.** 2016. Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin (RP-1691). *Science and Technology of the Built Environment* 22(4):431-462.
46. Azimi, P., Zhao, D., Pouzet, C., Crain, N., **Stephens, B.** 2016. Emissions of ultrafine particles and volatile organic compounds from commercially available desktop 3D printers with multiple filaments. *Environmental Science and Technology* 50(3):1260-1268.
47. Zhao, H., **Stephens, B.** 2016. A method to measure the ozone penetration factor in residences under infiltration conditions: Application in a multi-family apartment unit with multiple ozone monitors. *Indoor Air* 26(4):571-581.
48. Du, P., Wood, A., **Stephens, B.**, Song, X. 2015. Life-cycle energy implications of downtown high-rise vs. suburban low-rise living: an overview and quantitative case study for Chicago. *Buildings* 5:1003-1024.
49. Fazli, T., Yeap, R.Y., **Stephens, B.** 2015. Modeling the energy and cost impacts of excess static pressure in central forced-air heating and air-conditioning systems in single-family residences in the U.S. *Energy and Buildings* 107:243-253.
50. Zhao, D., Azimi, P., **Stephens, B.** 2015. Evaluating the long-term health and economic impacts of central residential air filtration for reducing premature mortality associated with indoor fine particulate matter (PM2.5) of outdoor origin. *International Journal of Environmental Research and Public Health* 12:8448-8479.
51. Leinartas, H., **Stephens, B.** 2015. Optimizing whole house deep energy retrofit packages: A case study of existing Chicago-area homes. *Buildings* 5:323-353.
52. Dedesko, S., **Stephens, B.**, Gilbert, J.A., Siegel, J.A. 2015. Methods to assess human occupancy and occupant activity in hospital patient rooms. *Building and Environment* 90:136-145.
53. Ramos, T., Dedesko, S., Siegel, J.A, Gilbert, J.A., **Stephens, B.** 2015. Spatial and temporal variations in indoor environmental conditions, human occupancy, and operational characteristics in a new hospital building. *PLoS ONE* 10(3): e0118207.
54. **Stephens, B.**, Adams, R.I., Bhangar, S., Bibby, K., Waring, M.S. 2015. From commensalism to mutualism: Integrating the microbial ecology, building science, and indoor air communities to advance research on the indoor microbiome. *Indoor Air* 25(1):1-3. (Editorial)
55. **Stephens, B.** 2015. Building design and operational choices that impact indoor exposures to outdoor particulate matter inside residences. *Science and Technology for the Built Environment*, 21:3-13.
56. Azimi, P., Zhao, D., **Stephens, B.** 2014. Estimates of HVAC filtration efficiency for fine and ultrafine particles of outdoor origin. *Atmospheric Environment* 98:337-346.
57. **Stephens, B.** 2014. The impacts of duct design on life cycle costs of central residential heating and air-conditioning systems. *Energy and Buildings*, 82:563-579.
58. Ramos T., **Stephens, B.** 2014. Tools to improve built environment data collection for indoor microbial ecology investigations. *Building and Environment* 81:243-257.
59. Susorova, I., Azimi, P., **Stephens, B.** 2014. The effects of climbing vegetation on the local microclimate, thermal performance, and air infiltration of four building facade orientations. *Building and Environment* 76:113-124.
60. El Orch, Z., **Stephens, B.,** Waring, M.S. 2014. Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the U.S. *Building and Environment* 74: 106–118.
61. Azimi, P., **Stephens, B.** 2013. HVAC filtration for controlling infectious airborne disease transmission in indoor environments: Predicting risk reductions and operational costs. *Building and Environment* 70:150-160.
62. **Stephens, B.,** Azimi, P., El Orch, Z., Ramos, T. 2013. Ultrafine particle emissions from desktop 3D printers. *Atmospheric Environment* 79:334-339.
63. Susorova, I., Angulo, M., Bahrami, P., **Stephens, B.** 2013. A model of vegetated exterior facades for evaluation of wall thermal performance. *Building and Environment* 67:1-13.

64. Shogan, B.D., Smith, D.P., Packman, A.I., Kelley, S.T., Landon, E.M., Bhangar, S., Vora, G.J., Jones, R.M., Keegan, K., **Stephens, B.**, Ramos, T., Kirkup, B.C., Levin, H., Rosenthal, M., Foxman, B., Chang, E.B., Siegel, J.A., Cobey, S., An, G., Alverdy, J.C., Olsiewski, P.J., Martin, M.O., Marrs, R., Hernandez, M., Christley, S., Morowitz, M., Weber, S., Gilbert, J. 2013. The Hospital Microbiome Project: Meeting Report for the 1st Hospital Microbiome Project, Chicago, USA, January 15th, 2013. *Standards in Genomic Sciences* 8(3). doi:10.4056/sigs.4187859.
65. **Stephens, B.**, Siegel, J.A. 2013. Ultrafine particle removal by residential HVAC filters. *Indoor Air* 23(6):488-497.
66. Gall, E.T., Carter, E.M., Earnest, C.M., **Stephens, B.** 2013. Indoor Air Pollution in Developing Countries: Research and Implementation Needs for Improvements in Global Public Health. *American Journal of Public Health* 103(4):e67-72.
67. **Stephens, B.**, Siegel, J.A. 2012. Penetration of ambient submicron particles into single-family residences and associations with building characteristics. *Indoor Air* 22(6):501-513.
68. **Stephens, B.**, Gall, E.T., Siegel, J.A. 2012. Measuring the penetration of ambient ozone into residential buildings. *Environmental Science and Technology* 46(2):929-936.
69. **Stephens, B.**, Siegel, J.A. 2012. Comparison of test methods for determining the particle removal efficiency of filters in residential and light-commercial central HVAC systems. *Aerosol Science and Technology* 46(5):504-513.
70. Carter, E., Earnest, C.M., Gall, E.T., and **Stephens, B**. 2012. Progress and priorities in reducing indoor air pollution in developing countries. *Indoor Air* 22(1):1-2. (Editorial)
71. Rhodes, J.D., **Stephens, B.**, Webber, M.E. 2011. Using a database of energy audits to investigate the impacts of common air-conditioning design and installation issues on peak power and energy consumption in Austin, Texas. *Energy and Buildings* 43(11):3271-3278.
72. **Stephens, B.**, Siegel, J.A., Novoselac, A. 2011. Operational characteristics of residential and light-commercial air-conditioning systems in a hot and humid climate zone. *Building and Environment* 46(10):1972-1983.
73. **Stephens, B.**, Carter, E.M, Gall, E.T., Earnest, C.M., Hun, D.E., Jackson, M.C., Walsh, E.A. 2011. Home Energy-Efficiency Retrofits. *Environmental Health Perspectives* 119(7):A283 (Correspondence article)
74. **Stephens, B.**, Novoselac, A., Siegel, J.A. 2010. The effects of filtration on pressure drop and energy consumption in residential HVAC systems (RP-1299). *HVAC&R Research* 16(3):273-294.
75. **Stephens, B.**, Siegel, J.A., Novoselac, A. 2010. Energy implications of filtration in residential and light-commercial buildings (RP-1299). *ASHRAE Transactions* 116(1):346-357.
76. Carter, E., Earnest, C., Gall, E., Guerrero, P., Hun, D., Jackson, M., Lo, J., **Stephens, B.**, Walsh, E. 2009. Priorities in indoor environmental science and health, as students see them. *Indoor Air* 19(6):444-445. (Editorial)

1.5.2 Papers under review in peer-reviewed journals

1. Mitkees, L., Heidarinejad, M., **Stephens, B.** Spatiotemporal variability in indoor environmental conditions and occupant thermal comfort in an iconic modernist building. Submitted to *Building Research and Information*, January 2023.

1.5.3 Book chapters

1. **Stephens, B.**, Maynard, A., and Hopke, P. 2022. Filtration and Air Cleaning. In Handbook of Indoor Air Quality. Edited by Prof. Yinping Zhang, Prof. Philip K. Hopke, and Dr. Corinne Mandin (Springer).

1.5.4 Peer-reviewed conference presentations and posters

Oral presenter is listed in *italics*:

1. *Mitkees, L.*, Heidarinejad, M., Stephens, B., Numerical Investigation of Thermal Comfort of a Thermally Active Student Desk (TASD) in a Virtual Domain of Historic S.R. Crown Hall Building. 2022 ASHRAE Building Performance Analysis Conference and SimBuild.
2. *McCreery, A.*, Gramigna, A., McKibbin, A., Kang, I., **Stephens, B.** The Breathe Easy Study: Air Quality, Health, and Energy Impacts of Ventilation Retrofits. 2022 ACEEE Summer Study on Energy Efficiency in Buildings. Pacific Grove, CA.
3. *Kang, I.*, Maristany, A., Corradi Dell'Acqua, E., **Stephens, B.**, Heidarinejad, M. 2022. Assessing the Impacts of Natural Ventilation on Building Energy Use: A Case Study of a Mid-Rise Residential Building in Chicago, IL. ASHRAE 2022 Winter Conference, Las Vegas, NV.
4. *Breen, M.*, Isakov, V., Prince, S., McGuinness, K., Egeghy, P., **Stephens, B.**, Arunachalam, S., Stout, D., Walker, W., Alston, L., Rooney, A., Taylor, K., Buckley, T. Using personal air sensor and GPS to determine microenvironment-specific exposures to volatile organic compounds. International Society of Exposure Science (ISES) 2021 (Virtual).
5. *Kang, I.*, Abromitis, K., Zeng, Y., Azimi, P., Evens, McCreery, A., Scheu, R., Gramigna, A., Crowder, T., Baca, G., **Stephens, B.** 2020. Indoor air quality and adult asthma severity in Chicago, IL. Indoor Air 2020, Seoul, South Korea (Virtual).
6. *Kang, I.*, Abromitis, K., Zeng, Y., Azimi, P., Evens, McCreery, A., Scheu, R., Gramigna, A., Crowder, T., Baca, G., **Stephens, B.** 2020. Demographics, housing characteristics, indoor environmental factors, and asthma severity among adults in Chicago, IL. Indoor Air 2020, Seoul, South Korea (Virtual).
7. ***Stephens, B.*** 2020. Multi-route modeling of Diamond Princess outbreak. Workshop on Transmission of SARS-CoV-2 and environmental intervention in indoor environment. Indoor Air 2020, Seoul, South Korea (Virtual).
8. *Zeng, Y.*, Kang, I., Abromitis, K., Azimi, P., **Stephens, B.** 2020. Evaluating the accuracy of optical particle counters for estimating size-resolved particulate matter mass concentrations in occupied homes. Indoor Air 2020, Seoul, South Korea (Virtual).
9. *Salimian Rizi, B.*, Riley, C., Ali, A., **Stephens, B.**, Heidarinejad, M. 2020. Energy analysis of steam distribution system using a physics-based model: a campus building case study. 2020 Building Performance Analysis Conference and SimBuild (ASHRAE and IBPSA-USA).
10. *Faramarzi, A.*, Delgoshaei, P., **Stephens, B.**, Heidarinejad, M. 2020. Comparing performance of optimization methods in optimal control and design of building energy and airflow models. 2020 Building Performance Analysis Conference and SimBuild (ASHRAE and IBPSA-USA).
11. *Khan, Z.,* Azari, R., **Stephens, B.** 2020. Outdoor thermal comfort (OTC) in human interaction based studies: an overview of review. 2020 Building Performance Analysis Conference and SimBuild (ASHRAE and IBPSA-USA).
12. *Scheu, R.*, Azimi, P., Guest, M.E., Gramigna, A., **Stephens, B.** 2018. Why equity matters: energy use and health disparities by neighborhood: stories (and data) from families living in Chicago's Bungalow Belt. American Council for an Energy-Efficient Economy (ACEEE) 2018 Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA.
13. Azimi, P., Zhao, H., Fazli, T., Zhao, D., Faramarzi, A., Leung, L., ***Stephens, B***. 2018. Changes in outdoor pollutant concentrations and environmental conditions along the height of a tall building. Indoor Air 2018, Philadelphia, PA.
14. *Azimi, P.*, **Stephens, B.** 2018. Predicting influenza exposures in multi-zone indoor environments using a complex infection transmission model. Indoor Air 2018, Philadelphia, PA.
15. *Azimi, P.*, **Stephens, B.** 2018. Estimates of the U.S. mortality burden attributable to exposure to fine particulate matter in indoor and outdoor microenvironments. Indoor Air 2018, Philadelphia, PA.

16. *Zhao, H.*, **Stephens, B.** 2018. Measuring the penetration factor of outdoor NO_2 and NO_x in an unoccupied apartment unit. Indoor Air 2018, Philadelphia, PA.
17. *Zhao, H.*, **Stephens, B.** 2018. Using improved methods to measure the transport of outdoor ozone and fine and ultrafine particulate matter into residential buildings. Indoor Air 2018, Philadelphia, PA.
18. Chin, K., Pleshakov, D., **Stephens, B.**, *Gall, E.* 2018. Ozone chemistry of building enclosure insulation materials. Indoor Air 2018, Philadelphia, PA.
19. *Cardona, C.*, Lax, S., Zhao, D., Winton, V., Raba, D., Goodney, G., Gao, P., Gottel, N., Hartmann, E., Thomas, P., Kelley, S., **Stephens, B.**, Gilbert, J. 2018. Microbial community and metabolic succession on common building materials under high relative humidity conditions. Indoor Air 2018, Philadelphia, PA.
20. ***Stephens, B.***, Harriman, L., Brennan, T., Ilacqua, V. 2018. An updated review of IAQ and health outcomes of air cleaner use in homes. Indoor Air 2018, Philadelphia, PA.
21. *Fazli, T.*, **Stephens, B.** 2018. Utilizing a nationally representative model set to predict the impacts of climate change on energy performance and IAQ in U.S. residences. Indoor Air 2018, Philadelphia, PA.
22. *Fazli, T.*, Zheng, Y., **Stephens, B.** 2018. Estimates of fine and ultrafine particle removal efficiency for residential HVAC filters using in-situ size-resolved efficiency measurements. Indoor Air 2018, Philadelphia, PA.
23. *Horin, B.*, **Stephens, B.** 2018. Characterizing the natural ventilation potential of a building site using a neural network for spatial estimates of outdoor air quality. Indoor Air 2018, Philadelphia, PA.
24. *Zhao, D.*, Raba, D., Cardona, C., Gottel, N., Thomas, P., Kelley, S., Gilbert, J., **Stephens, B.** 2018. The influence of material chemical composition on microbial dynamics of wetted building materials. Indoor Air 2018, Philadelphia, PA.
25. Azimi, P., Crowder, T., Evens, A., Garascia, M., Gramigna, A., *McCreery, A.*, Scheu, R., **Stephens, B.** 2018. Healthy housing and indoor air quality: A Chicago field study. Indoor Air 2018, Philadelphia, PA.
26. *Ali, A.*, **Stephens, B.** 2018. Open-source hardware and software platform for energy and indoor environmental quality monitoring and control. Indoor Air 2018, Philadelphia, PA.
27. *Faramarzi, A.*, Heidarinejad, M., **Stephens, B.** 2018. Modeling the energy impacts of underground garage ventilation strategies. Indoor Air 2018, Philadelphia, PA.
28. *Yu, H.*, Zhao, H., **Stephens, B.**, Verma, V. 2018. Comparison of the oxidative potential of size segregated aerosols of ambient origin in indoor and outdoor environments. Indoor Air 2018, Philadelphia, PA.
29. *Zakrzewski, T.*, **Stephens, B.** Building integrated cogeneration system design sizing and analysis for climate disruption. 2018 Building Performance Analysis Conference and SimBuild, co-organized by ASHRAE and IBPSA-USA, Chicago, IL.
30. *Zakrzewski, T.*, **Stephens, B.** Influence of energy codes and performance standards in building integrated cogeneration system design sizing. 2018 Building Performance Analysis Conference and SimBuild, co-organized by ASHRAE and IBPSA-USA, Chicago, IL.
31. ***Stephens, B.*** Airborne particulate matter in residences: challenges and opportunities for control. AHR Expo Session, "Keeping Occupants Happy and Healthy Through Affordable and Flexible Air and Water Control Strategies," ASHRAE 2018 Winter Conference, Chicago, IL.
32. *Azimi, P.*, **Stephens, B.** Estimates of the annual U.S. mortality burden attributable to fine particulate matter exposure in indoor and outdoor microenvironments. American Association for Aerosol Research (AAAR) 2017, Raleigh, NC.
33. *Fazli, T.*, **Stephens, B.** Characterizing the in-situ size-resolved removal efficiency of residential HVAC filters for fine and ultrafine particles. ASHRAE 2016 Winter Conference, Orlando, FL.
34. *Azimi, P.*, Zhao, D., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin (RP-1691). ASHRAE 2016 Winter Conference, Orlando, FL.

35. *Zhao, D.*, Azimi, P., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor PM2.5 of outdoor origin and associated chronic health risks. International Society for Exposure Science (ISES) 2015, Henderson, NV.
36. *Zhao, H.*, **Stephens, B.** Measuring the ozone penetration factor in a residence under infiltration conditions. International Society for Exposure Science (ISES) 2015, Henderson, NV.
37. *Azimi, P.*, Zhao, D., **Stephens, B.** Evaluating and controlling human exposure to ultrafine particle and VOC emissions from desktop 3D printers. International Society for Exposure Science (ISES) 2015, Henderson, NV. (**2nd place in the student poster competition**).
38. Zhao, D., Azimi, P., ***Stephens, B.*** The impact of HVAC filtration on indoor concentrations of outdoor PM2.5 inside residences. International Society for Exposure Science (ISES) 2015, Henderson, NV.
39. *Zhao, H.*, **Stephens, B.** A method to rapidly measure size-resolved particle penetration factors in residences. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.
40. *Fazli, T.*, **Stephens, B.** Characterizing the in-situ size-resolved removal efficiency of residential and light-commercial HVAC filters for particle sizes between 0.01 and 10 μm. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.
41. *Kunkel, S.*, Azimi, P., **Stephens, B.** Development of an experimental system for assessing indoor bioaerosol transport and control. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.
42. *Zhao, D.*, Azimi, P., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor PM2.5 of outdoor origin and associated chronic health risks. American Association for Aerosol Research (AAAR) 2015, Minneapolis, MN.
43. *Zhao, H.*, **Stephens, B.** Measuring the ozone penetration factor in a residence under infiltration conditions. Healthy Buildings America 2015, Boulder, CO.
44. *Zhao, H.*, **Stephens, B.** Measuring the ozone penetration factor in a residence under infiltration conditions. Healthy Buildings America 2015, Boulder, CO.
45. *Azimi, P.*, Zhao, D., **Stephens, B.** Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin. Healthy Buildings America 2015, Boulder, CO.
46. Ali, A., Fazli, T., Huan, J., Debose, D., Dong, B., ***Stephens, B.*** Open Source Building Science Sensors (OSBSS): An open source sensor network for indoor environmental data collection. Healthy Buildings America 2015, Boulder, CO.
47. *Zhao, D.*, Azimi, P., **Stephens, B.** Estimates of HVAC filtration efficiency for fine and ultrafine particles of outdoor origin. Healthy Buildings America 2015, Boulder, CO. (**Best student poster award**).
48. *Kunkel, S.*, Azimi, P., **Stephens, B.** Development of an experimental system for assessing indoor bioaerosol transport and control. Healthy Buildings America 2015, Boulder, CO.
49. *Fazli, T.*, Yeap, R.Y., **Stephens, B.** The energy consequences of excess static pressure in central residential heating and air-conditioning systems. Healthy Buildings America 2015, Boulder, CO.
50. ***Stephens, B.*** Built environment data collection: Updates on methods and sensor systems. Alfred P. Sloan Conference on the Microbiology of the Built Environment 2015, Boulder, CO.
51. Zhao, D., Azimi, P., ***Stephens, B.*** Modeling the impact of residential HVAC filtration on indoor $PM_{2.5}$ of outdoor origin. ASHRAE Annual Conference 2015, Atlanta, GA.
52. *Leinartas, H.A.*, **Stephens, B.** Optimization of cost-effective whole house retrofit packages for targeting 50% annual energy use reductions in existing Chicagoland homes. Engineering Sustainability 2015, Pittsburgh, PA.
53. Fazli, T., Yeap, R.Y., **Stephens, B.** The energy consequences of excess static pressure in residential heating and air-conditioning systems: differences between existing and new energy efficient homes. Engineering Sustainability 2015, Pittsburgh, PA.
54. Azimi, P., Zhao, D., **Stephens, B.** The impact of residential building characteristics on indoor particles of outdoor origin in three types of homes in multiple climates: Old homes, typical existing homes, and new sustainably built homes. Engineering Sustainability 2015, Pittsburgh, PA.

55. ***Stephens, B.*** The potential impacts of climate change on indoor air quality and health. Engineering Sustainability 2015, Pittsburgh, PA.
56. *Du, P.*, Wood, A., **Stephens, B.** Life Cycle Assessment of Urban vs. Suburban Residential Mobility in Chicago. Architectural Research Centers Consortium (ARCC) 2015 Annual Conference, Chicago, IL.
57. *Ali, A.*, Zanzinger, Z., **Stephens, B.** Open Source Building Science Sensors: an Open Source Sensor Network for Indoor Environmental Data Collection. IEEE SENSORS 2014, Valencia, Spain.
58. *Azimi, P.* and **Stephens, B.** Development and Application of a Markov Chain Model for Predicting Influenza Exposure in Indoor Environments. International Society for Exposure Science 2014, Cincinnati, OH.
59. El Orch, Z., Waring, M.S., ***Stephens, B.*** Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the U.S. International Society for Exposure Science 2014, Cincinnati, OH.
60. *Zhao, D.*, Azimi, P., **Stephens, B.** Estimates of HVAC Filtration Efficiency for Fine and Ultrafine Particles of Outdoor Origin. American Filtration and Separations Society (AFS) Fall Conference 2014, Chicago, IL.
61. ***Stephens, B.*** The Impacts of Duct Design on Life Cycle Costs of Central Residential Heating and Air-Conditioning Systems. 2014 ASHRAE/IBPSA-USA Building Simulation Conference, Atlanta, GA.
62. ***Stephens, B.***, Ali, A., Debose, D., Dong, B., Fazli, T. Open Source Building Science Sensors for Indoor Microbiology. Indoor Air 2014, Hong Kong.
63. El Orch, Z., Waring, M.S., ***Stephens, B.*** Predictions and determinants of size-resolved particle infiltration factors in single-family homes in the U.S. Indoor Air 2014, Hong Kong.
64. *Ramos, T.*, Azimi, P., Dide, L., Dedesko, S., Gilbert, J.A., Siegel, J.A., **Stephens, B.** Building Science Measurements in the Hospital Microbiome Project. Indoor Air 2014, Hong Kong.
65. ***Stephens, B.*** and Azimi, P. HVAC filtration for controlling airborne influenza transmission in indoor environments: predicting risk reductions and operational costs. Indoor Air 2014, Hong Kong.
66. ***Stephens, B.*** Building design and operational choices that impact indoor exposures to outdoor particulate matter inside residences. ASHRAE IAQ 2013, Vancouver, CA.
67. ***Stephens, B.***, Azimi, P., El Orch, Z., Ramos, T., Zylstra, R., Steele, J. Ultrafine particle emissions from desktop 3D printers. The 32nd Annual Conference of the American Association for Aerosol Research (AAAR), 2013, Portland, OR.
68. ***Stephens, B.*** How do building design and operational choices impact indoor exposures to outdoor air pollution? Engineering Sustainability 2013, Pittsburgh, PA.
69. ***Stephens, B.*** The impacts of building envelopes and central air-conditioning systems on indoor exposures to outdoor submicron particulate matter. The 22nd Annual Meeting of the International Society of Exposure Science (ISES), 2012, Seattle, WA.
70. ***Stephens, B.*** and Siegel, J.A. Ultrafine Particle Removal by Central Heating and Air-Conditioning Filters in a Test House. The 31st Annual Conference of the American Association for Aerosol Research (AAAR), 2012, Minneapolis, MN.
71. *Gall, E.T.*, **Stephens, B.**, Corsi, R.L., and Siegel, J.A. The impact of effective diffusion coefficients on transport and reaction to porous indoor materials. The 2nd International Conference on Building Energy and Environment (COBEE 2012).
72. *Rhodes, J.*, **Stephens, B.**, and Webber, M.E. Energy audit analysis of residential air-conditioning systems in Austin, Texas. 2012 ASHRAE Winter Conference.
73. ***Stephens, B.*** and Siegel, J.A. Novel methods to measure the penetration of ozone and particulate matter into residences. The 21st Annual Meeting of the International Society of Exposure Science (ISES), 2011, Baltimore, MD.

74. ***Stephens, B.*** and Siegel, J.A. Penetration of particulate matter into residential buildings: relationship with building air leakage characteristics. The 30th Annual Conference of the American Association for Aerosol Research (AAAR), 2011, Orlando, FL.
75. **Stephens, B.** and *Siegel, J.A.* A refined whole-house method to determine the in-situ particle removal efficiency of HVAC filters in residences. The 30th Annual Conference of the American Association for Aerosol Research (AAAR), 2011, Orlando, FL.
76. ***Stephens, B.*** and Siegel, J.A. Comparison of HVAC filter test methods for particle removal efficiency. Indoor Air 2011, Austin, TX.
77. ***Stephens, B.***, Gall, E.T., and Siegel, J.A. A method for measuring ozone penetration through the building envelope. Indoor Air 2011, Austin, TX.
78. ***Stephens, B.*** and Siegel, J.A. Do heating and air-conditioning filters affect energy use or indoor air quality? Poster: 2011 NSF IGERT Online Poster Competition (Top-10 Finalist).
79. ***Stephens, B.*** Modeling the effects of geography and climate on a net zero energy residence powered by solar PV in six climates. Engineering Sustainability 2011, Pittsburgh, PA.
80. ***Stephens, B.*** Modeling a net-zero energy residence: combining passive and active design strategies in six climates. ASHRAE 2011 Winter Conference, Las Vegas, NV.
81. ***Stephens, B.***, Siegel, J.A., and Novoselac, A. Energy implications of filtration in residential and light-commercial buildings (RP-1299). Poster: ASHRAE 2010 Winter Conference, Orlando, FL.
82. ***Stephens, B.***, Novoselac, A., and Siegel, J.A. 2009. Impacts of HVAC filtration on air-conditioner energy consumption in residences. In the Proceedings of Healthy Buildings 2009, Syracuse, NY.

1.5.5 Peer-reviewed technical reports

1. Azimi, P., Zhao, D., **Stephens, B.** 2015. Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin. Final report for ASHRAE Research Project RP-1691.
2. Fazli, T., Zhao, H., **Stephens, B.** 2015. Evaluating the moisture removal performance of Super Dry desiccants in footwear applications. Final report to Indoor Sciences, Inc.
3. **Stephens, B.** 2014. The impact of duct design on life cycle costs of central residential heating and air-conditioning systems. Final report for AHRI Project No. 8002.
4. **Stephens, B.**, Siegel, J.A., Novoselac, A. 2010. Energy implications of filtration in residential and light-commercial construction. Final report for ASHRAE Research Project RP-1299.

1.5.6 Other publications (op-eds, popular blog posts, reports, trade journals, etc.)

1. **Stephens, B.**, Gall, T., Heidarinejad, M., Farmer, D. 2022. Interpreting air cleaner performance data. *ASHRAE Journal*, May 2022.
2. **Stephens, B.** 2021. What air cleaner test reports don't tell you. Built Environment Research Group blog post: http://built-envi.com/what-air-cleaner-test-reports-dont-tell-you/.
3. **Stephens, B.** 2021. What kind of mask should I be wearing to protect against COVID-19? Built Environment Research Group blog post: http://built-envi.com/what-kind-of-mask-should-i-be-wearing-to-protect-against-covid-19/.
4. Morawska, L., Milton, D.K. 2020. It Is Time to Address Airborne Transmission of Coronavirus Disease 2019 (COVID-19). *Clinical Infectious Diseases* 71(9):2311-2313. **1 of 239 co-signers**.
5. Harriman, L., **Stephens, B.**, Brennan, T., 2019. New guidance for residential air cleaners. *ASHRAE Journal*, September 2019.
6. **Stephens, B.**, Corsi, R. Cutting EPA indoor air pollution research will cost money and lives. Op-ed in *The Hill*, February 2018. http://thehill.com/opinion/energy-environment/374562-cutting-epa-indoor-air-pollution-research-will-cost-money-and
7. **Stephens, B.**, Brennan, T., Harriman, L. 2016. Selecting ventilation air filters to reduce $PM_{2.5}$ of outdoor origin. *ASHRAE Journal*, September 2016.

8. Fazli, T., **Stephens, B.** 2016. In-situ residential HVAC filtration efficiency for fine and ultrafine particles. National Air Filtration Association *Air Media*, Fall 2016.
9. **Stephens, B.** 2015. Infiltration of outdoor pollutants. *Home Energy Magazine*, May/June 2015.
10. Contributor, www.microBE.net, blog posts for the Microbiology of the Built Environment Network: http://microbe.net/author/brent-stephens/.
11. **Stephens, B.** 2013. Filtration and infectious airborne disease transmission. National Air Filtration Association (NAFA) *Air Media*, Summer 2013, pages 4-16.
12. **Stephens, B.** 2013. Is that house an air filter? *Home Energy Magazine*, January/February 2013.
13. **Stephens, B.** 2012. Field measurements of filtration efficiency in homes. National Air Filtration Association *Air Media*, Summer 2012, pages 4-14.
14. Carter, E., Earnest, C.M., Gall, E.T., and **Stephens, B**. 2011. Student Symposium on Indoor Air Quality in Developing Countries: Full Meeting Report for NSF's IGERT.org: http://www.igert.org/documents/254.
15. **Stephens, B.** and Rhodes, J. 2011. "House Calls: Finding energy inefficiencies using residential energy audits." Guest blog post on Scientific American's blog network: Plugged In.
16. Rhodes, J. and **Stephens, B**. 2011. "Tighten up your house, but not too much…" Guest blog post, Scientific American's blog network: Plugged In.

1.6 Professional activities

1.6.1 Licensure

- Engineer in Training: Passed Fundamentals of Engineering Exam, May 2007

1.6.2 Professional Development Activities

- American Society for Engineering Education (ASEE) DELTA New Department Leaders Institute, January 2021

1.6.3 Professional service

• Member, National Advisory Committee (NAC) for the Model State Indoor Air Quality Act (MSIAQA) project, Johns Hopkins Center for Health Security	2023-present
• Technical Advisor, Illinois Stakeholders for Air Quality in Schools (ISAQS)	2023-present
• Member, National Academies of Sciences, Engineering, and Medicine (NASEM) Committee on Health Risks of Indoor Exposures to Fine Particulate Matter and Practical Mitigation Solutions	2021-present
• Member, ASHRAE Epidemic Task Force, Science Applications Team on Ventilation	2020-present
• Member, ASHRAE In-Room Air Cleaner Guidance Ad-hoc Committee	2020-present
• Member, ASHRAE Epidemic Task Force Residential Team	2020-2022
• External Examiner, MSc (Epidemiology) thesis, K. Velauthapillai, Department of Epidemiology, Biostatistics and Occupational Health, McGill University	2020
• Member, Low-Cost Indoor Air Quality Test Method Development Advisory Working Group, U.S. Department of Energy Building America project by Newport Partners, Home Ventilating Institute, the Healthy Air Research and Certification Authority, and the South Coast Air Quality Management District	2018-present
• Member, committee to update the ASHRAE Position Document on Indoor Air Quality (IAQ)	2018-2020

• Member, Technical Advisory Committee for DOE Building America New Home IAQ Study, led by Lawrence Berkeley National Laboratory	2017-present
• Secretary, International Society of Indoor Air and Climate (ISIAQ)	2016-2020
• Technical Chair, Indoor Air 2018, the 15th international conference of the International Society of Indoor Air and Climate (ISIAQ), Philadelphia, PA (Conference president: Michael Waring, Drexel University; over 800 registered participants)	2016-2018
• International Advisory Committee, Healthy Buildings Europe 2017 conference, Lublin, Poland	2016-2017
• Session organizer, "The next generation of ventilation", Indoor Air 2016, Ghent, Belgium	2016
• Session co-organizer, "Indoor environment data collection with today's technology," with Michael Waring and L. James Lo, Indoor Air 2016, Ghent, Belgium	2016
• Workshop co-organizer, "Microbiology of the Built Environment Study Methods," Healthy Buildings 2015, Boulder CO, funded by the Sloan Foundation	2015
• Workshop co-organizer, "Dissemination and Integration of Microbiology of the Built Environment Research," Healthy Buildings America 2015, Boulder CO, funded by the Alfred P. Sloan Foundation	2015
• Research Subcommittee Chair, ASHRAE TC 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment	2016-present
• Member, ASHRAE TC 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment	2014-2018
• Member, Science Advisory Board, Aquarium Microbiome Project, Shedd Aquarium	2015-2020
• Member, Advisory Board, Next Step Learning (ITEST), The Concord Consortium, Sponsored by NSF	2015-present
• Member, Technical Advisory Committee, "Healthy Efficient New Gas Homes," a project sponsored by the California Energy Commission and conducted by Lawrence Berkeley National Laboratory	2014-2019
• Chair, Scientific and Technical Committee 21 on Ventilation, ISIAQ	2014-2018
• Member, Scientific and Technical Committee 21 on Ventilation, ISIAQ	2014-present
• Member, Scientific and Technical Committee on Microbiology, ISIAQ	2014-present
• Healthy Buildings Europe 2015, Scientific Committee	2014-2015
• Healthy Buildings America 2015, Advisory Committee	2014-2015
• ISIAQ Mentorship Program Coordinator	2013-2014
• Scientific Program Committee (SPC), Environmental Health Conference	2012-2013
• Corresponding member, ASHRAE TC 4.3 Ventilation and infiltration	2012-present
• Workshop co-organizer, "Indoor air quality and cookstoves in developing countries," Indoor Air 2011, Austin, TX	2011
• Student organizing committee, Indoor Air 2011, Austin, TX	2011

1.6.4 Editorial board service

- Associate Editor, *Journal of Exposure Science and Environmental Epidemiology*, 2022-present
- Member, Editorial Board, *Indoor Air*, 2019-2022
- Member, Advisory Board, *Prometheus* (the journal of the IIT College of Architecture PhD program), 2019-present
- Member, Editorial Board, *Buildings,* 2018-2022

- Member, Editorial Board, Air & Waste Encyclopedia, Air & Waste Management Association (Wiley), 2018-present
- Member, Editorial Board, *Journal of Exposure Science and Environmental Epidemiology*, 2017-2022
- Guest editor, special issue on the Microbiology of the Built Environment, *Microbiome* (with Jack Gilbert), 2015
- Editorial board member, *AIMS Public Health*, 2013-2015

1.6.5 Journal reviewer

Most frequently reviewed:

- *Environmental Science and Technology*
- *Indoor Air*
- *Building and Environment*
- *Journal of Exposure Science and Environmental Epidemiology*
- *Atmospheric Environment*
- *Science of the Total Environment*
- *Aerosol Science and Technology*
- *Energy and Buildings*
- *Science and Technology of the Built Environment* (formerly *HVAC&R Research*)
- *Buildings*
- *Environmental Science and Technology Letters*

Reviewed, but less frequently:

- *Nature Communications*
- *Science Advances*
- *Scientific Reports*
- *Environmental Pollution*
- *Environmental Research*
- *Environmental Science: Processes and Impacts*
- *PLoS ONE*
- *Energies*
- *Aerosol and Air Quality Research*
- *Journal of Aerosol Science*
- *Frontiers in Microbiology*
- *BMC Medicine*
- *Indoor and Built Environment*
- *Energy Policy*
- *Applied Energy*
- *IEEE Transactions of Human-Machine Systems*
- *Automation in Construction*
- *Journal of the Air and Waste Management Association*
- *Journal of Occupational Medicine and Toxicology*
- *Journal of Hazardous Materials*
- *International Journal of Environmental Health Research*
- *Journal of Occupational and Environmental Health*
- *Journal of Building Engineering*
- *Microbiome*
- *JoVE*

1.6.6 Invited talks

1. "Filtration for Respiratory Exposure to wildfire Smoke from Swamp Cooler Air (FRESSCA)." Presentation to the New Mexico Climate and Health Adaptation Working Group, April 2023 (Virtual). With Gina Solomon (PHI), Mohammad Heidarinejad (IIT), and Aditya Singh (IIT).
2. "IAQ Monitoring Brown Bag." Presentation to Elevate, November 2022 (Virtual).
3. "Filtration and Air Cleaning for Airborne Pathogens." The National Academies of Sciences, Engineering, and Medicine (NASEM) Environmental Health Matters Initiative Indoor Air Management of Airborne Pathogens: Lessons, Practices, and Innovations, August 18, 2022 (Virtual).
4. "The Breathe Easy Study: Impacts of Ventilation Retrofits on Indoor Air Quality and Asthma," Webinar to the Green Home Institute, June 2022 (Virtual). With Anna McCreery (Elevate) and Insung Kang (IIT). Over 80 attendees.
5. "New DOE Zero Energy Design Designation: Preparing Students for a Clean Energy Workforce," Participant in webinar by the U.S. Department of Energy, May 2022 (Virtual).
6. "Navigating the Landscape of Air Cleaning Technologies for COVID-19," Presentation to the U.S. Environmental Protection Agency (EPA) Science Webinar Series, June 2021 (Virtual). With Elliott Gall (Portland State University). (Over 900 attendees registered and 457 live participants)
7. "The Breathe Easy Study: Health and Energy Impacts of Ventilation Improvements," Presentation to the Illinois Green Alliance, June 2021 (Virtual). With Anna McCreery (Elevate) and Insung Kang (IIT).
8. "Outdoor-to-Indoor Transport Mechanisms and Particle Penetration for Fine Particulate Matter," Presentation to the National Academies Workshop on Indoor Exposure to Fine Particulate Matter and Practical Mitigation Approaches, April 2021 (Virtual).
9. "Understanding the transmission and control of SARS-CoV-2 and COVID-19." Presentation to the master's program in civil engineering at Pontificia Universidad Javeriana, Bogota, Colombia, International Seminar Series, February 2021 (Virtual).
10. "A National Conversation on Indoor Air & K-12 Schools During the COVID-19 Pandemic." Participant in discussion led by the Johns Hopkins Center for Health Security, February 2021. Recording: https://www.centerforhealthsecurity.org/our-work/events/2021-Indoor-Air-K-12-Schools/webinar.html. Over 480 attendees (Virtual).
11. "Introduction to indoor air pollution." Guest lecture to EOHS 461 Environmental Public Health Practice, University of Illinois at Chicago (UIC), Dr. Jyotsna Jagai, February 2021 (Virtual).
12. "Air Ventilation Considerations in COVID-19 Jail and Prison Cases." ACLU (Virtual) Webinar, with Sachin Anand (dbHMS), January 2021.
13. "Broan Indoor Air Quality Expert Panel." Panel Discussion by Broan NuTone, with Joe Medsoch, and Rick Karg, January 2021 (Virtual).
14. "Mechanistic transmission modeling of COVID-19 on the Diamond Princess Cruise Ship demonstrates the importance of aerosol transmission." Presentation to the American Filtration and Separations (AFS) Society (Virtual), November 2020.
15. "Mechanistic transmission modeling of COVID-19 on the Diamond Princess Cruise Ship demonstrates the importance of aerosol transmission." Presentation to Indoor Air 2020 (Virtual), November 2020.
16. "Civil, Architectural, and Environmental Engineering." Presentation to Von Steuben Metropolitan Science Center, Chicago, IL (Virtual), October 2020.
17. "Microbial exchange in the built environment." Presentation to Occupant Behavior and Microbiology of the Built Environment workshop, Notre Dame, South Bend, IN, September 2019.
18. "Estimating the mortality burden of fine particulate matter exposure attributable to indoor and outdoor microenvironments." U.S. Environmental Protection Agency IAQ Science Series Webinar, with Parham Azimi, June 2019 (over 750 attendees registered and 359 live participants).
19. "Particle filtration fundamentals." Presentation the 2019 National Home Performance Conference session on High MERV Filters in Central Air Handler: Opportunities & Challenges, Chicago, IL, April 2019.

20. "Energy and air quality in buildings." Presentation to the UIC Summer Institute on Sustainability and Energy, Illinois Institute of Technology, Chicago, IL, August 2018.
21. "Can we improve the indoor environment and cut carbon emissions at the same time?" Presentation to the WISER Joint Symposium on Carbon Management, Illinois Institute of Technology, Chicago, IL, April 2018.
22. "Moving to mass-based HVAC filtration metrics." Presentation to the National Air Filtration Association (NAFA) Technical Seminar, Kansas City, MO, April 2018.
23. "Critically reading and writing articles and visual display of quantitative information." Presentation to ARCH 602 Crafting a Dissertation, Illinois Institute of Technology, Chicago, IL, March 2018.
24. "Airborne particulate matter in residences: challenges and opportunities for control." Presentation to ASHRAE AHR Expo special session, Chicago, IL, January 2018.
25. "Research developments on rapid assessment tools for building/home inspections." Presentation to Sloan Microbiology of the Built Environment Research to Practice Workshop, Orlando, FL, January 2018.
26. "Updates to the EPA Guide to Air Cleaners in the Home." Presentation to Filtration 2017, Chicago, IL, October 2017.
27. "Energy and air quality in the built environment." Presentation to the Illinois Tech College of Architecture PhD program seminar, Chicago, IL, October 2017.
28. "Energy implications of indoor agriculture." Presentation to Illinois Tech IPRO 497 course, UFarmIIT: Innovative Automation Using Renewable Energy, taught by Prof Hamid Arastoopour, Chicago, IL, October 2017.
29. "Energy and air quality in the built environment." Presentation to the Illinois Tech Department of Electrical and Computer Engineering Seminar Series, Chicago, IL, September 2017.
30. "Energy and air quality in the built environment." Presentation to the Illinois Tech Homecoming Research Showcase, Chicago, IL, September 2017.
31. "Energy and air quality in the built environment." Presentation to the Illinois Tech Summer Immersion Program, Chicago, IL, September 2017.
32. "Indoor exposures to outdoor air pollution." Lunch plenary speaker presentation to the Engineering Sustainability 2017 conference, Pittsburgh, PA, April 2017.
33. "Indoor exposures to outdoor air pollution." Presentation to the University of Illinois at Urbana-Champaign Environmental Engineering Graduate Seminar, February 2017.
34. "Combining measurements and models to predict the impacts of climate change and weatherization on indoor air quality and chronic health effects in U.S. residences." Presentation to the 2016 U.S. Environmental Protection Agency (EPA) Science to Achieve Results (STAR): Indoor Air & Climate Change Progress Review Meeting, Howard University, December 2016.
35. "Outdoor pollutant penetration through building enclosures." Presentation to Tremco Roofing lecture, Illinois Institute of Technology, October 2016.
36. "What have we learned about the microbiomes of indoor environments?" Webinar and discussion for the U.S. Environmental Protection Agency (EPA), September 2016.
37. "Perspectives on microbial interactions in built environments," Presentation to the National Academies Committee on Microbiomes of the Built Environment: From Research to Application, June 2016, Washington, DC.
38. "Microbiology of the built environment (MoBE) research and architectural engineering," Presentation to the Sloan MoBE Early Career Workshop, Chicago, IL, April 2016.
39. "Understanding the mechanistic drivers of indoor exposures to outdoor air pollution," Presentation to the graduate environmental engineering seminar, Virginia Tech, April 2016.
40. "Open source building science sensors (OSBSS): An open source platform for indoor environmental data collection," Presentation to Dr. Linsey Marr's graduate air pollution class, Virginia Tech, April 2016.
41. "Open source building science sensors (OSBSS): An open source platform for indoor environmental data collection," Presentation to College of Architecture PhD program, Illinois Institute of Technology, March 2016.

42. "Outdoor air and (non-combustion) appliances as sources of indoor particulate matter (PM)," Presentation to the IOM National Academies Workshop on the Health Risks of Indoor Exposure to particulate Matter, February 2016, Washington, DC.
43. "Understanding the mechanistic drivers of indoor exposures to outdoor air pollution," Presentation to the graduate environmental engineering seminar, Washington State University, February 2016.
44. "Introduction to indoor air quality (IAQ)," Webinar series for IPMM 510, Illinois Institute of Technology, November 2015.
45. "Open source building science sensors (OSBSS): An open source platform for indoor environmental data collection," Web presentation to Dr. Jing Du's Construction IT graduate course at Texas A&M University, October 2015.
46. "Building science measurements for microbiology of the built environment studies: How and why?" Presentation for workshop, Alfred P. Sloan Foundation Microbiology of the Built Environment Study Methods, Healthy Buildings America 2015, Boulder CO.
47. "Improving built environment data collection for investigations of the microbiology of the built environment," Presentation for workshop, Alfred P. Sloan Foundation Dissemination and Integration of Microbiology of the Built Environment Research, Healthy Buildings America 2015, Boulder CO.
48. "Energy and air quality in the built environment," Presentation to Spring 2015 Portland State University Department of Mechanical Engineering Seminar Series, Portland, OR, April 2015.
49. "Energy and air quality in the built environment," Presentation to Spring 2015 University of Illinois at Chicago (UIC) Department of Civil and Materials Engineering, Chicago, IL, February 2015.
50. "Energy and air quality in the built environment," Presentation to Spring 2015 Graduate Seminar series, Illinois Institute of Technology, Chicago, IL, February 2015.
51. "Indoor concentrations of outdoor pollution," Webinar presentation to Reducing Outdoor Contaminants in Indoor Spaces (ROCIS), funded by the Heinz Endowments, Southwestern PA, November 2014.
52. "Ultrafine particle emissions from desktop 3D printers," Presentation to an NSF-sponsored workshop on the Environmental Implications of Additive Manufacturing, hosted by the University of Florida and the Woodrow Wilson International Center for Scholars, National Science Foundation, Arlington, VA, October 2014.
53. "Indoor exposures to outdoor air pollution," Presentation to Dr. Aaron Packman's Spring 2014 Northwestern University CE 260 Introduction to Environmental Engineering undergraduate course, Evanston, IL, May 2014.
54. "Indoor exposures to outdoor air pollution," Presentation to Spring 2014 University of Illinois at Chicago (UIC) Occupational and Environmental Health and Safety ERC Seminar, Chicago, IL, April 2014.
55. "Energy and air quality in the built environment," Presentation to Spring 2014 Northwestern University Environmental Engineering Graduate Seminar, Evanston, IL, February 2014.
56. "Energy and air quality in the built environment," Presentation to Spring 2014 Graduate Seminar series, Illinois Institute of Technology, Chicago, IL, February 2014.
57. "Building design and operational choices that impact indoor exposures to outdoor particulate matter inside residences." Invited presentation to ASHRAE 2014 Winter Conference, New York, NY.
58. **"**Building science measurements in the Hospital Microbiome Project." Invited presentation to ASHRAE 2014 Winter Conference, New York, NY.
59. "Filtration for the prevention of airborne infectious disease transmission," Presentation to Filtration 2013, Chicago, IL, November 14, 2013.
60. "Indoor exposures to outdoor air pollution," Presentation to the ACSA/AIA Housing Research Lecture Series Webinar, October 7, 2013.
61. "Residential HVAC filtration: energy and airflow impacts," Presentation to the ASHRAE SSPC 62.2 IAQ subcommittee, ASHRAE 2013 Annual Conference, Denver, CO, June 21, 2013.

62. "Energy and environmental impacts of buildings," Presentation to the ASCE-Illinois 3rd Annual Sustainability Workshop, Chicago, IL, June 13, 2013.
63. "Filtration and the Wells-Riley model for infectious disease transmission risk," Presentation to the 2013 National Air Filtration Association (NAFA) Technical Seminar, Louisville, KY, April 11, 2013.
64. "Energy and Air Quality in the Built Environment," Presentation to Fall 2012 Graduate Seminar series, Illinois Institute of Technology, Chicago, IL, October 24, 2012.
65. "Energy and Air Quality in the Built Environment," Presentation to Fall 2012 Graduate Seminar series, Tennessee Technological University, Cookeville, TN, September 25, 2012.
66. "Field Measurements of Filtration Efficiency in Homes," Presentation to the 2012 National Air Filtration Association (NAFA) Technical Seminar, Phoenix, AZ, April 19, 2012.
67. "Indoor Air Quality in Developing Regions of the World," Presentation to CE396L.6: Human Exposure to Indoor Air Pollution, with Ellison Carter; Instructor: Dr. Richard Corsi, The University of Texas at Austin, Austin TX, April 17, 2012.
68. "Energy and Air Quality in Austin Homes," Presentation to the Austin Energy Green Building Seminar Series, Austin, TX, January 18, 2012 (with Joshua D. Rhodes).
69. "Indoor Air Quality in Developing Regions of the World," Web presentation to Arch Eng 366: Indoor Air Pollution, with Ellison Carter; Instructor: Dr. Glenn Morrison, Missouri University of Science and Technology, from Austin, TX, December 2, 2011.
70. "Indoor Air Quality in Developing Regions of the World," Presentation to Indoor Environmental Technical Information Exchange course, with Ellison Carter, Matt Earnest, and Elliott Gall; Instructor: Dr. Richard Corsi, The University of Texas at Austin, Austin TX, March 4, 2011.
71. "Chemical Culprits from Corrosive Drywall: An Engineering Analysis," Presentation at the 2010 Indoor Air Quality Association (IAQA) Annual Meeting and Exposition, Tampa, FL, March 9, 2010.
72. "Energy and Indoor Air Quality: Implications of HVAC Filtration," Presentations to the Austin Energy Green Building Seminar Series, Austin, TX, March 5, 2010, and Tom Green & Co. Engineers, Inc., Austin, TX, January 18, 2010.
73. "Pecan Street Project: Energy Modeling," Presentation to UT School of Architecture, Seminar in Sustainable Design; Instructor: Dr. Werner Lang, The University of Texas at Austin, Austin, TX, July 21, 2009.
74. Presentation and workshop at "Steps toward a Sustainable Austin Energy" Symposium, Austin, TX, March 10, 2009. Contents available online: http://www.utexas.edu/lbj/news/story/732/

1.6.7 Consulting experience

I have worked periodically as a consultant for the following organizations/projects:

- Indoor Science: Scientific Advisory Board Member (2022-present)
- American Civil Liberties Union (ACLU): Pro bono consulting on ventilation for COVID-19 transmission in jails and prisons (2020-present)
- Lehigh County Court, PA: Pro bono consulting on ventilation for COVID-19 transmission in courthouses (2020)
- U.S. Environmental Protection Agency (EPA) Indoor Environments Division (IED) under consulting agreement #13302-01-6 to the Scientific Consulting Group (SCG): Updating the U.S. EPA's "Guide to Air Cleaners in the Home" and "Residential Air Cleaners" Technical Summary documents (2017-2019)
- U.S. Environmental Protection Agency (EPA) Indoor Environments Division (IED) under consulting agreement #13302-01-6 to the Scientific Consulting Group (SCG): Estimating the impact

of indoor exposures to particulate matter of both indoor and outdoor origin on adverse health outcomes (2016-2020)

- U.S. Environmental Protection Agency (EPA) Indoor Environments Division (IED) under consulting agreement #13302-01-6 to the Scientific Consulting Group (SCG): Reviewing and updating its flood cleanup guidance document, "Technical Report on Flood-Related Cleaning" (2015-2016)

1.7 Contributions to administration and university service

1.7.1 Service to the university (IIT)

• Member, Faculty Information & Data Task Force, IIT	2022-2023
• Member, Community Engaged Research Consortium, IIT	2021-present
• Provost Fellow and Member, Big Bets Subcommittee, Illinois Tech Strategic Envisioning Committee	2021-2022
• Member, IIT College of Architecture Faculty Search Committee, Building Technology Position	2021, 2023
• External Member, IIT College of Architectural NAAB Accreditation	2021
• Member, IIT Armour College of Engineering Dean Search Committee	2020
• Member, IIT College of Architecture Dean Search Committee	2018-2019
• Member, American Institute of Architects (AIA) Design and Health Research Consortium, IIT Team (with Rahman Azari, Architecture, and Nichole Ditchman, Psychology)	2018-2020
• Faculty mentor, Architectural Engineering Institute (AEI)	2017-2019
• Member, University Research Council	2016-2018
• Mentor, DOE Solar Decathlon Design Challenge (formerly Race to Zero)	2016-present
• Faculty mentor, Engineers Without Borders (EWB)	2014-2018
• Began a joint Ph.D. specialization between CAEE and the College of Architecture (CoA) in Technologies of the Built Environment	2014
• Mentor, ACE Program for Undergraduate Research in Engineering (PURE)	2013-present
• Scholarship Symposium interviewer	2013-present
• Rettaliata Classroom Design Development Committee	2013
• Rettaliata Interactive Learning Design Development Committee	2013
• ACE Student-Led Project program adviser, greenhouse design/construction	2013
• ASHRAE-IIT student chapter faculty advisor	2012-present

1.7.2 Service to the department (CAEE)

• Department Chair, CAEE	2018-present
• Freshman and transfer student advisor (with Dr. Steve Kleps)	2018-present
• Program Director, Environmental Engineering	2019-present
• Chair, Architectural Engineering faculty search committee	2017
• Member, CAEE Leadership Transition Team (interim chair committee)	2016-2018
• Member, CAEE Department Chair search committee	2016-2017
• Member, CAEE Graduate Seminar Committee	2015-2017
• Interviewed staff and students for CAEE chair review	2015
• Consultant to CAE 495 Senior Design Capstone	2015-present
• Faculty search committee, Construction Engineering & Management, CAEE	2014
• Started a new thesis-based M.S. Architectural Engineering degree	2014

- Program Director, Architectural Engineering 2014-present
- US DOE Net Zero Energy Student Design Competition, faculty advisor 2014-present
- Introduction to CAEE, Discover IIT Day 2012-present
- B.S./M.E./M.S./Ph.D. advisor for IIT Architectural Engineering program 2012-present
- Member, architectural engineering program curriculum committee 2012

1.8 Professional honors, listings, awards, and research support

1.8.1 Professional honors and awards

- 2022: People's Gas Energy Forum Innovation Strategies and Technologies Award for our Battery Operated Radiator Controller (BORC) project
- 2022: Named the Arthur W. Hill Endowed Chair in Sustainability
- 2022: Sigma Xi/IIT Award for Excellence in Research (Full Professor)
- 2022: Armour College of Engineering Dean's Award for Excellence in Advising
- 2019: Authentic Experience Award, IIT Faculty Appreciation Luncheon (for work with admissions in 2018-2019)
- 2019: Outstanding Professor Award, IIT Chapter of the American Society of Civil Engineers (ASCE)
- 2016: Exceptional Professor Award, IIT Chapter of the American Society of Civil Engineers (ASCE)
- 2015: ASHRAE New Investigator Award

1.8.2 Research grants and contracts awarded at IIT

To date, I have received **$3.95 million** in external research funding as PI or co-PI on over 25 projects totaling approximately $6.3 million across all co-PIs. 78% of my external research funding ($3.1 million) has been awarded with me as the lead PI. These projects have been funded by the U.S. Environmental Protection Agency (EPA); the Alfred P. Sloan Foundation (APSF); the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE); the Centers for Disease Control (CDC) through the National Institute for Occupational Safety and Health (NIOSH); the Department of Housing and Urban Development (HUD); the Air-Conditioning, Heating and Refrigeration Institute (AHRI); the Council on Tall Buildings and Urban Habitat (CTBUH); the National Air Filtration Association (NAFA) Foundation; and others. I have also received **$72,965** in gifts in support of my research and **$95,000** in internal funding from IIT. A full summary of my awarded external research funding is provided below.

Summary of external research funding:

1. 2023-present: Performance Optimization of Custom Battery-Powered Radiator Controls and Low-Cost Steam Trap Monitoring System. Franklin Energy Services, LLC. Role: Co-PI. PI: Mohammad Heidarinejad (**$110,275**).
2. 2022-present: Filtration for respiratory exposure to wildfire smoke from swamp cooler air (FRESSCA). U.S. Environmental Protection Agency (US EPA). Role: Co-PI and IIT PI (IIT portion: **$203,690**). PI: Public Health Institute (PHI) (Total project budget: $994,407). Co-PIs: Mohammad Heidarinejad (IIT), University of California San Francisco, University of Colorado Boulder, California Department of Public Health, Central California Environmental Justice Network.
3. 2021-2022: Battery-powered custom radiator controls and low-cost steam trap monitoring. Franklin Energy Services, LLC. Role: Co-PI. PI: Mohammad Heidarinejad (**$70,000**).
4. 2020-2021: Energy savings potential of ECM motors in homes. ComEd. Role: Co-PI (IIT portion: **$44,100**). PI: Elevate Energy (Total project budget: $250,000).

5. 2019-present: Air filtration to improve indoor air quality (IAQ) and chronic obstructive pulmonary disease (COPD) outcomes in a high-risk urban population of U.S. military veterans. U.S. Department of Housing and Urban Development (HUD). Role: PI (**$1,000,000**). Co-PIs: Mohammad Heidarinejad (IIT); Israel Rubinstein (University of Illinois at Chicago and Jesse Brown Veterans Affairs Medical Center); Anne Evens (Elevate Energy).
6. 2019-2021: Novel radiator control system. Franklin Energy Services, LLC. Role: PI (**$81,125**). Co-PI: Mohammad Heidarinejad (IIT). Amended April 2020 with addition **$40,000**.
7. 2018: Garage demand control ventilation study. Nagle Energy Solutions. Role: Co-PI (my portion: **$4,406**). PI: Mohammad Heidarinejad (IIT) (Total project budget: $21,000).
8. 2017-2018: Open source wireless building sensors and controls. Franklin Energy Services, LLC. Role: PI (**$59,125**).
9. 2017: Undergraduate building science laboratory: HVAC systems and measurements. ASHRAE Undergraduate Program Equipment Grant. Role: PI (**$5,000**).
10. 2017-2018: Evaluating the impact of energy efficiency retrofits on long-term health and economic outcomes associated with indoor ozone and particulate matter. ASHRAE Graduate Student Grant-in-Aid Award to Haoran Zhao. Role: PI (**$10,000**).
11. 2016-2021: Cost-effective approaches to upgrading residential mechanical ventilation systems to control indoor pollutants of both indoor and outdoor origin and improve asthma-related health outcomes. U.S. Department of Housing and Urban Development (HUD). Role: PI (**$699,612**). Co-PI: Elevate Energy.
12. 2016: 3D printer emissions testing. Aleph Objects, Inc. Role: PI (**$9,600**).
13. 2016: Vertical variations in indoor exposures to outdoor pollutants in tall buildings. Council on Tall Buildings and Urban Habitat (CTBUH) International Research Seed Funding. Role: PI (**$20,000**).
14. 2016: Thermoplastic polyurethane 3D filament emissions during 3D printing. Fenner Drives, Inc. Role: PI (**$3,600**).
15. 2015-2018: Mechanistic modeling of microbial metabolic succession in the built environment. Alfred P. Sloan Foundation. Role: Co-PI (IIT portion: **$279,747**). PI: Jack Gilbert (Total project budget: $880,068).
16. 2015-2017: Evaluating the impacts of building enclosures and HVAC filtration on airborne particulate matter and energy efficiency in residential buildings. ASHRAE New Investigator Award. Role: PI (**$100,000**).
17. 2015-2016: Modeling the impact of mechanical ventilation and HVAC filtration compliance pathways in ASHRAE Standard 62.2 on fine and ultrafine particles inside residences. ASHRAE Graduate Student Grant-in-Aid Award to Parham Azimi. Role: PI (**$10,000**).
18. 2015-2016: Characterizing the in-situ size-resolved removal efficiency of residential and light-commercial HVAC filters for particle sizes between 0.01 μm and 10 μm. ASHRAE Graduate Student Grant-in-Aid Award to Torkan Fazli. Role: PI (**$10,000**).
19. 2014-2019: Combining measurements and models to predict the impacts of climate change and weatherization on indoor air quality and chronic health effects in U.S. residences. U.S. Environmental Protection Agency (US EPA). Role: PI (**$499,974**).
20. 2014-2016: Evaluating and controlling airborne emissions from desktop 3D printers. Centers for Disease Control (CDC), National Institute of Occupational Safety and Health (NIOSH). Role: PI (**$140,451**).
21. 2014: Building science to advance research on the microbiology of the built environment (workshop). Alfred P. Sloan Foundation. Role: PI (**$25,447**).
22. 2014: Modeling the impact of residential HVAC filtration on indoor particles of outdoor origin. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) RP-1691. Role: PI (**$40,998**).
23. 2014-2016: Indoor bioaerosol fate, transport and control: Implications for infectious disease transmission. Alfred P. Sloan Foundation. Microbiology of the Built Environment (MoBE) Postdoctoral Fellowship advisor to Stephanie Kunkel, Department of Biological and Chemical Sciences, IIT. Role: PI (**$120,000**).

24. 2013-2015: Open source building science sensors project. Alfred P. Sloan Foundation. Role: PI (**$163,340**).
25. 2012-2014: Building science measurements for the Hospital Microbiome Project. Alfred P. Sloan Foundation. Role: Subcontract to the University of Chicago (IIT portion: **$38,089**). PI: Jack Gilbert (Total project budget: $800,000).
26. 2012: Linking HVAC filtration and the Wells-Riley approach to assessing risks of infectious airborne diseases. National Air Filtration Association (NAFA) Foundation. Role: PI (**$5,086**).
27. 2012-2013: Impact of duct design on life cycle cost of residential HVAC systems. Air-Conditioning, Heating, and Refrigeration Institute (AHRI). Role: PI (**$33,336**).

Summary of gifts ($72,965 received):

1. 2021: Unrestricted gift in support of ongoing research on indoor air cleaning technologies. Crowd-sourced support through a JustGiving campaign with a target of $25,000 (**$25,565** received; 102% of goal). https://www.justgiving.com/fundraising/parents-unite
2. 2021: Unrestricted gift in support of ongoing research on portable air cleaning technologies. Indoor Sciences (**$10,000**).
3. 2016: Unrestricted gift in support of ongoing research into the emissions of particles and gases from desktop 3D printers and filaments. Aleph Objects (**$6,400**).
4. 2015: Unrestricted gift in support of ongoing research into the penetration of ambient pollutants into indoor microenvironments. American Petroleum Institute. (**$20,000**).
5. 2014: Unrestricted gift in support of ongoing research evaluating the moisture removal performance of desiccants. Indoor Sciences, Inc. (**$1,000**).
6. 2014: Unrestricted gift in support of ongoing research into the penetration of ambient pollutants into indoor microenvironments. American Petroleum Institute. (**$10,000**).

Summary of total internal research funding ($95,000 awarded):

1. 2020: IIT Faculty Innovation Grant. Low-cost indoor air quality sensors for remote instruction during COVID-19, for ENVE 576 Indoor Air Pollution Summer course. PI: Mohammad Heidarinejad. Role: Co-PI. (**$2,000**).
2. 2020: WISER ISFG. Personalized thermal comfort systems in historical buildings. PI: Mohammad Heidarinejad. Role: Co-PI. (**$28,000**).
3. 2017: WISER ISFG. Understanding global transboundary politics and pollution. PI: Matthew Shapiro. Role: Co-PI. (**$25,000**).
4. 2015: WISER ISFG. Towards a center for sustainable and efficient urban agriculture. Co-PI: Rodger Cooley, College of Architecture. Role: PI. (**$25,000**).
5. 2012: Starr-Fieldhouse Fellowship. Indoor air microbial sampling and human occupancy detection inside hospital patient rooms. Student: Tiffanie Ramos, M.S. candidate. Collaborator: Dr. Jack Gilbert, Argonne National Laboratory. Role: PI. (**$15,000**).

1.9 Membership in professional societies (past and/or current)

- American Association for Aerosol Research (AAAR, current)
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE, current)
- International Society of Exposure Science (ISES, current)
- International Society of Indoor Air Quality and Climate (ISIAQ, current)
- National Air Filtration Association (NAFA, past)

EXHIBIT 4

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

ROBERT S. GARNER, on behalf of himself and all others similarly situated,

Plaintiff,

v.

GLOBAL PLASMA SOLUTIONS INC.,

Defendant.

C.A. No. _____

JURY TRIAL DEMANDED

CLASS ACTION COMPLAINT

TABLE OF CONTENTS

Plaintiff Robert S. Garner brings this action on behalf of himself and all others similarly situated against Defendant Global Plasma Solutions Inc. Plaintiff makes the following allegations pursuant to the investigation of counsel and based upon information and belief, except as to the allegations specifically pertaining to himself, which are based on personal knowledge.

INTRODUCTION

1. Global Plasma Solutions Inc. preys on people desperate to cleanse the air and protect themselves from ailments including the COVID-19 virus.

2. Despite representations that its Products[1] clean the air – including eliminating the COVID-19 virus – Defendant's products make the air worse for people because the products reduce some volatile organic compounds (VOCs) but **actually increase the concentration of other VOCs**.

[1] The Products included with this definition include all products that used Defendant's NPBI technology. Presently this includes the GPS-FC48-AC, GPS-FC24-AC, GPS-DM48-AC, GPS-FC-3-BAS, GPS-IMOD, GPS-IRIB-18, and GPS-IRIB-36.

3. To further its deception – while also hiding significant defects in its Products – Defendant deceptively represents company-funded testing as "independent" while also using test conditions that are not representative of the real-world use of the Products.

4. Defendant's "profits over people" scheme won the company acclaim, publicity, and generated hundreds of millions of dollars in sales at the expense of the Plaintiff and Class Members across the country.

5. "The worst thing that can happen is installing a product you believe is keeping you safe, but it's not."[2] But that is precisely what GPS is doing, instilling customers with a false sense of security through misleading claims.

6. Further, Defendant overstates its Products' COVID-19 mitigation performance and uses methods that are "unvalidated"[3] and

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[2]Quote from Global Plasma Solutions Vice President of Sales David Archer. *Why Your Customers Should Care About Their Indoor Air Quality* https://globalplasmasolutions.com/articles/why-your-customers-should-care-about-their-indoor-air-quality.

[3] Talia Wiener, *Parents Tell Montclair District: We're Worried New Air Cleaners Aren't' Safe*, MONTCLAIR LOCAL (April 22, 2001), https://www.montclairlocal.news/2021/04/22/parents-tell-montclair-district-were-worried-new-air-cleaners-arent-safe/.

"under conditions that are not representative of actual application conditions."[4]

7. For example, in one instance, Global Plasma Solutions used a chamber the size of a shoebox to support its claim that its Products could kill COVID-19 for a home or school. In another instance, Global Plasma Solutions "blasted" the testing chambers with 27,000 ions per cubic centimeter – far in excess than concentrations achievable by its Products.

8. When Defendant's Products have been independently tested in real world conditions, they consistently fail to achieve the results as represented by Defendant.

9. COVID-19 has taken more than 578,000 American lives.

10. In an effort to capture dollars from COVID-19 fear, Defendant markets directly to consumers seeking protection and relief from the virus.

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[4] Ross Pomeroy, *Schools Are Spending Millions on Ionization Technology to Fight COVID and There's No Good Evidence It Works*, MASS LIVE (January 22, 2021), https://www.masslive.com/coronavirus/2021/01/schools-are-spending-millions-on-ionization-technology-to-fight-covid-and-theres-no-good-evidence-it-works.html.

11. This tactic is "enhanced" by Defendant's marketing which provides information to consumers on how to obtain government funding to purchase Defendant's Products.

12. These "free money" purchases boost the Defendant's revenues by not only taking from tax funds but also shifting these precious dollars away from effective means of virus mitigation.

13. However, as Defendant knows, its Products suffer from defects which cause its Products to fail to meet its lofty representations. Thus, the Defendant's representations that its products are a safe technology to cleanse the air of VOCs and the COVID-19 virus without generating harmful byproducts is false, misleading, and designed to deceive consumers into paying a price premium and choosing its products over a competitor's product.

14. In pursuit of "profits over people," Global Plasma Solutions uses many deceptive representations as described herein.

15. For example, Defendant deceptively represented that its technology was installed in the White House for COVID mitigation: [5]

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[5] Gregory Barber, *The Ionizer in Your School May Not Do Much to Fight Covid*, WIRED (March 26, 2021), https://www.wired.com/story/ionizer-school-not-fight-covid/.

> A spokesperson for the company directed WIRED to research commissioned by the company showing the technology neutralized SARS-CoV-2 on surfaces and aerosols in lab settings, as well as case studies from customers including universities and the White House.

However, the technology was installed in 2018 – well before COVID-19 appeared.[6]

16. Defendant manufactures, sells, and distributes the Products using marketing and advertising campaigns specifically targeted to consumers that are aware and fearful of the COVID-19 virus.

17. For example, in CEO Glenn Brinckman's words, "it's all about pathogens and coronavirus and COVID-19."[7]

18. Plaintiff and those similarly situated ("Class Members") relied on Defendant's misrepresentations.

19. Defendant's fraudulent, deceptive, and misleading conduct violated and continues to violate the consumer protection statutes of multiple states. Further, Defendant breached and continues to breach

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[6] Additionally concerning, Defendant used the White House logo in its marketing to project legitimacy of its Products even though the White House logo may not be used for marketing purposes.

[7] Ashley Fahey, *Add Air Quality to The Growing List of Items Landlords Should Consider Before Workers Return to The Office*, CHARLOTTE BUSINESS JOURNAL (May 6, 2020), https://www.bizjournals.com/charlotte/news/2020/05/06/add-air-quality-to-the-growing-list-of-items.html?iana=hpmvp_clt_news_headline.

its implied and express warranties regarding the Products. Additionally, Defendant has been and continues to be unjustly enriched. Accordingly, Plaintiff brings this action against Defendant on behalf of himself and Class Members who purchased the Products during the applicable statute of limitations period (the "Class Period").

PARTIES

20. Plaintiff is a citizen of Maryland and domiciled therein.

21. Defendant Global Plasma Solutions, Inc. is a Delaware corporation with its principal place of business located in Charlotte, NC. Defendant manufactures, markets, and distributes its products throughout the United States.

22. Plaintiff reserves the right to amend this Complaint to add different or additional defendants, including without limitation any officer, director, employee, supplier, or distributor of Defendant who has knowingly and willfully aided, abetted, or conspired in the false and deceptive conduct alleged herein.

23. Whenever reference is made in this Complaint to any representation, act, omission, or transaction of a defendant, that allegation shall mean that the defendant did the act, omission, or

transaction through its officers, directors, employees, agents, and/or representatives while they were acting within the actual or ostensible scope of their authority.

JURISDICTION AND VENUE

24. This Court has personal jurisdiction over the Defendant because the Defendant is incorporated in the State of Delaware; has consented to jurisdiction by registering to conduct business in this state; maintains sufficient contacts in Delaware; and otherwise intentionally avails itself of the markets within Delaware through the promotion, sale, marketing and distribution of its Products in and from Delaware, which renders the exercise of jurisdiction by this Court proper and necessary as Defendant is "at home" in Delaware.

25. This Court has original subject-matter jurisdiction over this proposed class action pursuant to 28 U.S.C. § 1332(d), which, under the provisions of the Class Action Fairness Act ("CAFA"), explicitly provides for the original jurisdiction of the federal courts in any class action in which at least 100 members are in the proposed plaintiff class, any member of the plaintiff class is a citizen of a State different from any defendant, and the matter in controversy exceeds the sum of

$5,000,000.00, exclusive of interest and costs. Plaintiff alleges that the total claims of individual members of the proposed Class (as defined herein) are well in excess of $5,000,000.00 in the aggregate, exclusive of interest and costs. In addition, this Court has supplemental jurisdiction over Plaintiff's state law claims under 28 U.S.C. § 1367.

26. Venue is proper in this District under 28 U.S.C. § 1391 because Defendant is incorporated within this District and a substantial part of the events or omissions giving rise to the claims occurred within this District.

FACTUAL ALLEGATIONS

A. The Market for Air Treatment Systems

27. The COVID-19 pandemic has caused demand for air treatment systems (ATS) to skyrocket.

28. In 2020, the ATS market grew by 57% and is expected to have a double-digit growth rate in each of the next two years.[8]

29. Market growth at these rates is unprecedented.

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[8] *Air Purifier Sales Surge in the U.S. Amid the COVID-19 Pandemic*, VERIFY MARKETS (January 26, 2021), https://www.globenewswire.com/news-release/2021/01/26/2164712/0/en/Air-Purifier-Sales-Surge-in-the-U-S-Amid-the-COVID-19-Pandemic.html.

30. For example, one air filter company CEO was so overwhelmed with orders that he had to turn customers away and stated, "I've been in this business for 20 years and this is the most chaotic time I've ever had in the air filter business."[9] In summary, he described the demand from customers as "like toilet paper in April [2020] times two."[10]

31. As a result of COVID-19's airborne transmission, residential and commercial customers sought air treatment systems to ensure safety.

32. COVID-19 has taken more than 575,000 American lives.

33. Certain underlying medical conditions that are relatively common in the population produce a significantly increased risk of death when a person is infected with COVID-19.

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[9] Will Feuer, *Airborne Transmission of Coronavirus Has Made High-End Air Filtration Systems More Popular Than 'Toilet Paper in April' As HVAC Systems Sell Out*, CNBC (October 15, 2020), https://www.cnbc.com/2020/10/15/airborne-transmission-of-coronavirus-has-made-high-end-air-filtration-systems-more-popular-than-toilet-paper-in-april.html.

[10] *Id.* (referring to the demand for toilet paper during the onset of the pandemic that led to shortages, fights, and arrests as consumers battled for toilet paper).

34. For example, one common underlying condition is age. Compared to the CDC reference group, adults aged 30-39 are 45x more likely to die from COVID and 10x more likely to be hospitalized.[11]

35. With each successive age group, these numbers increase drastically until hitting frightening numbers for people aged 65 and above:

Age Range	Death	Hospitalization
65-74	1300x	40x
75-84	3200x	65x
85+	8700x	95x

36. To protect people, locations that have high amounts of "foot traffic" in an indoor setting have invested in safety precautions to mitigate the spread of COVID-19.

37. The feeling of safety and security is pivotal to the public. As a result, there is strong demand for goods and procedures that "may make people feel safer without actually being substantially safer."[12]

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[11] Center for Disease Control, *Older Adults*, https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html (updated April 16, 2021).
[12]Lindsay Christians, *Cold Comfort: With Winter On Its Way, Madison Restaurants Scramble To Stay Alive*, THE CAPITAL TIMES (November 7, 2020), https://madison.com/ct/entertainment/dining/cold-comfort-with-winter-on-its-way-madison-restaurants-scramble-to-stay-alive/article_2fdc210d-f78e-55cb-a251-96fc41516a1e.html.

38. Installation of air treatment systems has been one of the most popular mitigation efforts.

39. Because of the strong likelihood of death for the elderly population, senior living facilities have invested heavily in air treatment systems.

40. Because of the strong likelihood of children acting as super spreaders,[13] schools from coast to coast invested heavily in air treatment systems to protect not only the students and school staff but also their friends and family.

41. Because of the strong desire to celebrate their faith in person, religious organizations throughout the country invested in air treatment systems to allow congregations to worship safely.

42. In addition to these public areas, similar concerns caused demand and interest to swell with residential owners.

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[13] MGH News and Public Affairs, *Children's Role In Spread Of Virus Bigger Than Thought*, THE HARVARD GAZETTE (August 20, 2020), https://news.harvard.edu/gazette/story/2020/08/looking-at-children-as-the-silent-spreaders-of-sars-cov-2/.

43. One survey found that the COVID-19 pandemic caused a 54% increase in consumer focus for indoor air quality in their homes.[14]

44. The Wall Street Journal labeled clean air as the next luxury apartment perk, and Elisa Orlanski Ours, Chief Planning and Design Officer for Corcoran Sunshine, stated, "Air quality is now front of mind for our buyers."[15]

45. Throughout every business sector and every home, demand for clean air and the equipment that creates the perception of clean air is growing exponentially.

46. To harness this demand, companies, like Global Plasma Solutions, have increased marketing efforts and product lines.

B. Global Plasma Solutions: The Company and the Products

47. Global Plasma Solutions was founded in 2008. The company's previous focus was providing energy savings solutions. However, when the COVID-19 pandemic hit, the company's focus

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[14] *New Survey Reveals Increased Concern for Air Quality and Safety in Homes*, PR NEWSWIRE (October 28, 2020), https://www.prnewswire.com/news-releases/new-survey-reveals-increased-concern-for-air-quality-and-safety-in-homes-301162159.html.

[15] Katy McLaughlin, *CLEAN AIR: THE NEXT LUXURY APARTMENT PERK*, WALL STREET JOURNAL (December 9, 2020), http://www.wsj.com/articles/clean-air-the-next-luxury-apartment-perk-11607526064.

shifted, and in CEO Glenn Brinckman's words, "it's all about pathogens and coronavirus and COVID-19."[16]

48. The backbone of Global Plasma Solutions' product line is its patented Needlepoint Bipolar Ionization technology (NPBI).

49. NPBI is used in all seven of Defendant's Products.

C. Global Plasma Solutions Represents to Consumers that Its Products Will Improve Air Quality Without Harmful Side Effects

50. In marketing the Products, Defendant makes numerous representations regarding the performance and abilities of its Products and the benefits purchasers should expect to gain therefrom.

51. This uniform, widespread marketing campaign is coordinated to present universal representations concerning the effectiveness of Defendant's Products and the NPBI technology.

52. These representations fall into a few broad categories:

a. Representations that the Products are superior to other air treatment system technologies;

b. Representations that the Products eliminate VOCs;

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[16] Ashley Fahey, *Add Air Quality to The Growing List of Items Landlords Should Consider Before Workers Return to The Office*, CHARLOTTE BUSINESS JOURNAL (May 6, 2020), https://www.bizjournals.com/charlotte/news/2020/05/06/add-air-quality-to-the-growing-list-of-items.html?iana=hpmvp_clt_news_headline.

c. Representations that the Products have no harmful byproducts;

d. Representations that the Products are safe to use;

e. Representations that the Products produce cleaner air;

f. Representations that the Products are capable of achieving quantified toxin-removal benchmarks (for example, that its technology can reduce SARS-CoV-2 by 98.33% within 60 minutes);

g. Representations that Defendant's assertions about the Products are based on "independent testing;"

h. Representations that attempt to capitalize on the COVID-19 pandemic.

53. These representations are false, misleading, and deceptive:

Representation Category	False, Misleading, and Deceptive
Products are superior to other air treatment system technologies	Comparisons to other technologies are based on the other misrepresentations herein.
Products eliminate VOCs	Independent studies show the Products actually increase the concentration of other harmful VOCs.
Products have no harmful byproducts	Independent studies show the Products' byproducts include harmful toxins including Acetone, Ethanol, Toluene, and Butyraldehyde.

Products are safe to use	Independent studies show the Products' byproducts include harmful toxins including Acetone, Ethanol, Toluene, and Butyraldehyde.
Products produce cleaner air	Independent studies show that the Products are not effective at cleaning the air in real world conditions. Further, the studies show that the Products' byproducts include harmful toxins including Acetone, Ethanol, Toluene, and Butyraldehyde.
Products are capable of achieving quantified toxin-removal benchmarks (for example, that its technology can reduce SARS-CoV-2 by 98.33% within 60 minutes)	These benchmarks fail to be replicated in real world environments.
Defendant's assertions about the Products are based on "independent testing"	Defendant's testing is fundamentally flawed and biased because these company-funded studies are not "independent." Further, Defendant's test results are not replicated in real world conditions because Defendant's tests are carefully constructed in order to achieve the outcomes Defendant desires.
Attempts to capitalize on the COVID-19 pandemic	Through a coordinated campaign to profit from COVID-19 fear, Defendant overstates the efficacy of its Products' ability to eliminate COVID-19.

54. These representations were promulgated to the public through Defendant's website, social media, YouTube videos, testimonials, third party publications, and other media. Below is a non-exhaustive selection of the representations made by Global Plasma Solutions concerning its NBPI Products.

55. Defendant represents that its Products are superior to other air treatment system technologies.[17]

a. "That's why GPS is committed to science and ongoing research to ensure we have **the safest, most effective technology on the market.**" Charles Waddell, GPS' Founder and Chief Technology Officer.[18]

b. "Most important, **unlike many other solutions on the market, GPS NPBI technology is also safe for occupied spaces.**"[19]

c. In a podcast interview, shared on the Global Plasma Solutions' official Facebook page on June 15, 2020, Founder and CTO, Charlie Waddell states:[20]

i. "You know, half the filters and UV lights are what I consider passive devices, they sit there and they wait for stuff to come to them. **Our technology NPBI is**

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[17] Emphasis added throughout.
[18] Global Plasma Solutions, *The Future of Indoor Air Quality Is Now*, https://globalplasmasolutions.com/articles/the-future-of-indoor-air-quality-is-now.
[19] Global Plasma Solutions, *PROJECT SPOTLIGHT: Boston Children's Hospital*, https://globalplasmasolutions.com/articles/project-spotlight-boston-childrens-hospital.
[20] Global Plasma Solutions' Official Facebook Page, June 15, 2020, https://www.facebook.com/globalplasmasolutions/posts/190279179097329.

> **actually going out into the space and seeking out these contaminants within the space. So that's really solving the problems as we see them today.** Where you have people talking coughing, sneezing, generating the actual contaminants in the space. So I would rather see a technology actively coming out into the space to treat those contaminants versus waiting for them to come back to the air handler to be reactive versus proactive."[21]

d. In a presentation entitled "How to Make your HVAC System Pandemic Ready using Needlepoint Bipolar Ionization" by Charlie Waddell, Defendant's Founder and CTO:[22]

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[21] *Id.* at approximately the 4:00 minute mark.

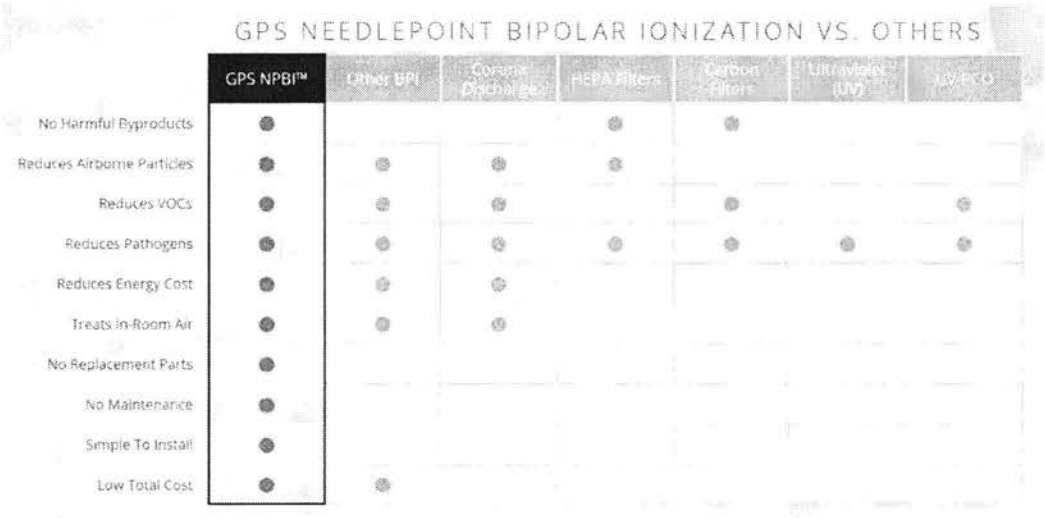
[22] Global Plasma Solutions Presentation (conducted by Charlie Waddell), How to Make your HVAC System Pandemic Ready using Needlepoint Bipolar Ionization, https://www.total-mechanical.com/wp-content/uploads/2020/09/How-to-Make-Your-HVAC-Pandemic-Ready.pdf.

% of SARS VIRUS CONTROLLED BASED ON TECHNOLOGY[1]

MERV Rating	Filter Only	Filter+UVC***	Filter + Ionization*, **
6	6.2%	10%	34%
7	7%	12%	61%
8	11%	19%	84%
10	12%	35%	89%
13	46%	84%	97%
15	71%	97%	99%
16	76%	98.80%	99.90%
17 (HEPA)	99.90%	99.99%	99.999%

*Ionization increases the filter efficiency 4-5 MERV levels – this column added by GPS
**Does not take into account ionization kills in the space and on surfaces
***UVC does not effectively kill airborne pathogens in high RH conditions[2]

e. In a sales presentation from September 1, 2020, Defendant compares its technology vs. competitor technologies:[23]



[23] Global Plasma Solutions Sales Presentation, Better Air through Science, September 1, 2020, https://www.sde.idaho.gov/communications/files/public-records-requests/GPS-Presentation.pdf (slide 13).

56. Defendant represents that its Products eliminate VOCs.[24]

a. "Odors neutralized by **destroying VOCs**."[25]

b. "Needlepoint bipolar ionization (NPBI®) technology breaks down odors into basic, harmless compounds, **leaving indoor air smelling fresh and free of odor-causing volatile organic compounds (VOCs)**."[26]

c. "The GPS-iMOD, which is UL 2998-listed for no ozone, helps control fine particles while **destroying VOCs**."[27]

d.

THE GPS ADVANTAGE

	GPS NPBI	OTHER BPI	CORONA DISCHARGE	HEPA FILTERS	CARBON FILTERS	ULTRAVIOLET (UV)	UV-PCO
Produces Harmful Byproducts	None	Yes	Yes	No	No	Yes	Yes
Reduces Airborne Particles	✔	Yes	Yes	Yes	No	No	No
Destroys VOCs	✔	Yes	Yes	No	Captures	No	Yes

[28]

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[24] Emphasis added throughout.

[25] Global Plasma Solutions, Product Data Sheet: GPS-FC48-AC, https://globalplasmasolutions.com/uploads/products/data-sheets/GPS-FC48-AC_Data-Sheet.pdf (citing to the GPS-FC48-AC, but this representation is present on every single Product's Data Sheet).

[26] Global Plasma Solutions, *PROJECT SPOTLIGHT: Clean Room Applications*, https://globalplasmasolutions.com/articles/project-spotlight-clean-room-applications.

[27] Global Plasma Solutions Sales Presentation, Better Air through Science, September 1, 2020, https://www.sde.idaho.gov/communications/files/public-records-requests/GPS-Presentation.pdf (slide 49).

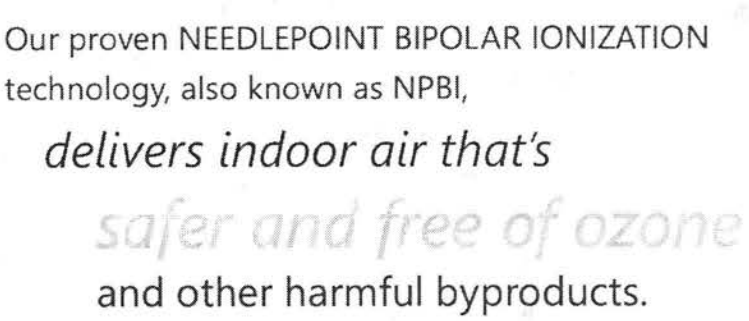
[28] Global Plasma Solutions Brochure, p. 3, https://resource.carrierenterprise.com/is/content/Watscocom/iwave_gps-fc-3-bas_article_1604089090642266_en_cc1.

57. Defendant represents that its Products have no harmful byproducts.[29]

a. "Are there **byproducts**?

No. Passing through an ionization field causes compounds to break into one or more of four basic elements: oxygen, nitrogen, carbon dioxide or water vapor."[30]

b. In a sales presentation from September 1, 2020:[31]



[29] Emphasis added throughout.
[30] Global Plasma Solutions FAQ Page, https://globalplasmasolutions.com/faqs (last visited May 6, 2021).
[31] Global Plasma Solutions Sales Presentation, Better Air through Science, September 1, 2020, https://www.sde.idaho.gov/communications/files/public-records-requests/GPS-Presentation.pdf.

GPS' NPBI™ technology breaks down chemical, pet, cooking and other odors into basic harmless compounds, leaving indoor air fresh smelling and free of odor-causing VOCs.

The NPBI plasma breaks down odors, gases and VOC's into harmless compounds.

c. "Safe solution: NPBI delivers clean indoor air **without producing** ozone or other **harmful byproducts**."[32]

[32] Global Plasma Solutions, *To Bring Employees Back Safely, This Agency Turned to Ionization Technology*, https://globalplasmasolutions.com/articles/to-bring-employees-back-to-work-safely-this-agency-turned-to-ionization-technology.

d. 

[33]

e. "Since 2009, GPS has delivered clean indoor air solutions that are safe and healthy. **Our technology delivers clean indoor air without producing ozone or other harmful byproducts.**"[34]

f. "GPS' technology generates the same ions as Mother Nature creates with lightning, waterfalls, and ocean waves. Mother Nature uses energy to break apart molecules. It is nature's way of cleansing the air naturally and creating a healthy environment. The only difference is that GPS' technology does it **without forming ozone or other harmful byproducts.**"[35]

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[33] Global Plasma Solutions Sales Presentation, Better Air through Science, September 1, 2020, https://www.sde.idaho.gov/communications/files/public-records-requests/GPS-Presentation.pdf.

[34] Global Plasma Solutions, *Global Plasma Solutions® Appoints Edward Sobek as Chief Science Officer*, March 2, 2021, https://globalplasmasolutions.com/articles/indoor-air-quality-solutions-leader-global-plasma-solutions-appoints-edward-sobek-as-chief-science-officer.

[35] Global Plasma Solutions Marketing Brochure, http://www.icecenter.net/covid/bipolar-ionization.pdf.

g. "GPS NPBI technology is certified by UL 867 and UL 2998, meaning it delivers indoor air that's free of ozone and other harmful byproducts. **This sets it apart from other ionization technologies that are known to produce ozone, making them unsafe for occupied spaces."**[36]

58. Defendant represents that its Products are safe to use.[37]

a. "For the immediate and post-pandemic new normal, GPS is uniquely positioned to address IAQ and pathogen control challenges by providing an **effective, safe and dependable solution**."[38]

b. "GPS NPBI technology helps with all aspects of indoor air quality. In addition, **unlike many other solutions on the market, it's also safe for occupied spaces**. This means

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[36] Global Plasma Solutions, *Why Your Customers Should Care About Their Indoor Air Quality*, https://globalplasmasolutions.com/articles/why-your-customers-should-care-about-their-indoor-air-quality.

[37] Emphasis added throughout.

[38] Global Plasma Solutions, *The Future of Indoor Air Quality Is Now*, https://globalplasmasolutions.com/articles/the-future-of-indoor-air-quality-is-now.

building occupants can get back to work, school and more in **a safe manner**."[39]

c. "**Safer**, fresher indoor air"[40]

d. "Many are turning to Global Plasma Solutions' NPBI technology as an affordable, **safe, effective solution.**"[41]

e. In a podcast interview, shared on the Global Plasma Solutions' official Facebook page on June 15, 2020, Founder and CTO, Charlie Waddell has the following discussion:

i. Question: "Okay. So, you said that it didn't produce ozone. And so that's often a concern with bipolar ionization. And so is there anything that this the NPI technology could how it could adversely affect components or occupants? Or is it completely safe?"

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[39] Global Plasma Solutions, *10 Facts About Needlepoint Bipolar Ionization*, https://globalplasmasolutions.com/articles/10-facts-about-needlepoint-bipolar-ionization.

[40] This representation appears throughout Defendant's website. For example, it appears on the "Transportation," "Office Buildings," and "Health Care" tabs under "Markets Served."

[41] Global Plasma Solutions, *PROJECT SPOTLIGHT The University of Maryland, Baltimore*, https://globalplasmasolutions.com/articles/project-spotlight-the-university-of-maryland-baltimore.

Answer: "**It is completely safe**. And the reason why we can make that claim is because we don't produce the ozone as a byproduct. With the older systems and other types of technologies that may compete against NBPI. They are producing ozone as a byproduct, and a lot of people like to go out and market it as ozone free technology, or they'll claim they don't produce ozone. But really, where the rubber meets the pavement is actually being able to produce that test report from UL that states per 2998 you don't produce ozone. So for those people out there using these other technologies, that ASHRAE has now come out and said in their ASHRAE standards in Section 5.7.1, if you look that up, it'll say all air purification technologies that require power should have UL 2998 certification and that confirms that, in fact, **it is a safe technology**. If we're not creating the ozone, we're not going to be oxidizing or breaking down any organics in the airstream. **So it's safe and effective**. And actually, I just read a great

paper from the National Institutes of Health that discussed on ionization and the positive impact that actually has on health. So I was very pleased to see that coming from the NIH."[42]

ii. Later in that same interview at approximately 13:13 minute mark: "So that's **safe** in itself, and confirmed by third party that **it's safe**."

f. "GPS patented NPBI® technology **safely and effectively** reduces airborne viruses and other pathogens while also making dust, pollen and other particles easier to capture in air filtration systems."[43]

g. On the first page of a marketing document distributed to potential customers:[44]

> ***GPS is Safe***
> Our needlepoint bipolar ionization is OZONE free and safe to use across commercial, industrial and residential buildings. Traditional bipolar ionization systems produce harmful ozone as a byproduct.

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[42] Global Plasma Solutions Official Facebook Page, https://www.facebook.com/globalplasmasolutions/posts/190279179097329 at approximately the 8:00 mark.
[43] Global Plasma Solutions, Large Spaces, https://globalplasmasolutions.com/applications/large-spaces.
[44] Global Plasma Solutions, INDEPNDENT LABORATORY TEST RESULTS, https://newhorizonacademy.net/wp-content/uploads/2020/08/GPS_Pathogen_Testing_Summary_6.10.20.pdf.

h. "GPS' NPBI (needlepoint bipolar ionization) products are **completely safe for humans and animals**. With over 250,000 installations and many testimonials, GPS products have not only **proven to be safe,** but they also make the air cleaner and **safer**. GPS technology produces what naturally occurs in nature, and since GPS' technology has been certified by UL 2998 as ozone-free, **there are no health concerns**."[45]

i. "Needlepoint bipolar ionization (NPBI®) technology is a **safe and effective** way to filter the virus out of the air."[46]

j. "NPBI technology **safely and effectively** tackles airborne viruses and other pathogens while also making dust, pollen and other particles easier to capture in air filtration systems."[47]

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[45] Global Plasma Solutions FAQ Page, https://globalplasmasolutions.com/faqs (last visited May 5, 2021).
[46] Global Plasma Solutions, *The American Rescue Plan Can Help Schools Reopen Safely*, https://globalplasmasolutions.com/articles/the-american-rescue-plan-can-help-schools-reopen-safely-with-air-purification-technology.
[47] Global Plasma Solutions, *Project Spotlight: Amalie Arena*, https://globalplasmasolutions.com/articles/project-spotlight-amalie-arena.

59. Defendant represents that its Products produce cleaner air.[48]

a. "**CLEANER AIR**, NATURALLY"[49]

b. "Through our needlepoint bipolar ionization or NPBI® technology, **we deliver clean indoor air** — producing neither ozone nor other harmful byproducts."[50]

c. "NPBI is a proactive approach to **cleaner air**."[51]

d. "This instantly results **in cleaner indoor air** and a safer environment."[52]

e. GPS products provide an affordable, effective and low-maintenance **solution for cleaner air**.[53]

f. "AN ENGINEERED SOLUTION FOR **CLEANER, SAFER** INDOOR AIR"[54]

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[48] Emphasis added throughout.
[49] Global Plasma Solutions, How It Works, https://globalplasmasolutions.com/how-it-works (last visited May 5, 2021).
[50] *Id.*
[51] Global Plasma Solutions, *The American Rescue Plan Can Help Schools Reopen Safely*, https://globalplasmasolutions.com/articles/the-american-rescue-plan-can-help-schools-reopen-safely-with-air-purification-technology.
[52] *Id.*
[53] *Id.*
[54] Global Plasma Solutions, *Why Your Customers Should Care About Their Indoor Air Quality*, https://globalplasmasolutions.com/articles/why-your-customers-should-care-about-their-indoor-air-quality.

g. "The combined effect is air that is **cleaner and safer** to breathe."[55]

h. In March 2021, Global Plasma Solutions appointed Edward Sobek as the company's first Chief Science Officer. In the press release announcing his arrival, Mr. Sobek states: [56]

i. "What is most compelling about NPBI is its ability to **clean air and surfaces** in the occupied space."

ii. "This technology can help create **healthy environments** at home, at work, at school and beyond. I welcome the opportunity to further GPS' goal of improving indoor air quality for all."[57]

i. "**GPS delivers clean indoor air** without producing ozone or other harmful byproducts."[58]

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[55] Global Plasma Solutions, *PROJECT SPOTLIGHT The Learning Experience*, https://globalplasmasolutions.com/articles/project-spotlight-the-learning-experience.
[56] Global Plasma Solutions, *Global Plasma Solutions® Appoints Edward Sobek as Chief Science Officer*, March 2, 2021, https://globalplasmasolutions.com/articles/indoor-air-quality-solutions-leader-global-plasma-solutions-appoints-edward-sobek-as-chief-science-officer (emphasis added).
[57] *Id.*
[58] Global Plasma Solutions, Pathogen Reduction, https://globalplasmasolutions.com/pathogen-reduction (last visited May 5, 2021).

j. "Our patented needlepoint bipolar ionization (NPBI®) technology is a **proactive approach to cleaner air**."[59]

60. Defendant represents that its Products can achieve toxin-removal benchmarks.[60]

a. "**Within 24 hours of installation**, NPBI technology **effectively neutralized odors from all sources** entering these buildings."[61]

b. For example, the following tables appear on both the Defendant's "Independent Testing" and "Pathogen Reduction" pages:

i.

Pathogen	Time in Chamber	Testing Methodology	Rate of Reduction
SARS-CoV-2	60 minutes	In-Air	98.33%
SARS-CoV-2	60 minutes	Surface	99.98%

[59] Global Plasma Solutions, *The Japanese Industrial Standard for Ion Measurement*, https://globalplasmasolutions.com/articles/the-japanese-industrial-standard-for-ion-measurement.
[60] Emphasis added throughout.
[61] Global Plasma Solutions, *Project Spotlight: Edmonton International Airport*, https://globalplasmasolutions.com/articles/project-spotlight-edmonton-international-airport.

ii.

Pathogen	Time in Chamber	Rate of Reduction
Tuberculosis	60 minutes	69.1%
MRSA	30 minutes	96.2%
Staphylococcus	30 minutes	96.2%
E. coli	15 minutes	99.7%

iii.

Pathogen	Time in Chamber	Rate of Reduction
Norovirus'	30 minutes	93.5%
Human Coronavirus 229E*	60 minutes	99.0%
Legionella	30 minutes	99.7%
Clostridium Difficile	30 minutes	88.9%

c. "The air purification system was able to target and reduce pathogens and odors **within just 24 hours of installation**."[62]

d. "The GPS-iMOD **drastically reduced the exhaust fume odors within 24 hours** and **reduced the particles in the space by up to 85%**."[63]

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[62] Global Plasma Solutions, *PROJECT SPOTLIGHT: Clean Room Applications*, https://globalplasmasolutions.com/articles/project-spotlight-clean-room-applications.
[63] Global Plasma Solutions, *PROJECT SPOTLIGHT The University of Maryland, Baltimore*, https://globalplasmasolutions.com/uploads/customer-resources/Resource-Library/Case-Studies/University-of-Maryland-Case-Study.pdf (emphasis in original).

61. Defendant represents that its assertions about the Products are based on "independent testing."[64]

a. "This process is **proven by independent laboratory testing** to be both safe and effective."[65]

b. In a presentation entitled "How to Make your HVAC System Pandemic Ready using Needlepoint Bipolar Ionization" by Charlie Waddell, Defendant's Founder and CTO:[66]

Independent Testing by World Renowned EMSL & ATS Labs

c. On its website, under the "Independent Testing" page:[67]

i.

Independent Testing

We put our needlepoint bipolar ionization (NPBI®) technology to the test. Third-party testing confirms it limits the spread of viruses.

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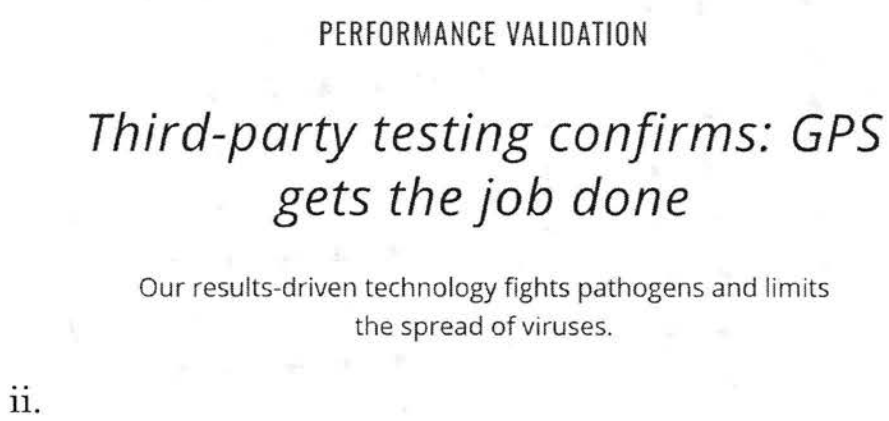
[64] Emphasis added throughout.
[65] Global Plasma Solutions, Pathogen Reduction, https://globalplasmasolutions.com/pathogen-reduction (last visited May 5, 2021).
[66] Global Plasma Solutions Presentation (conducted by Charlie Waddell), How to Make your HVAC System Pandemic Ready using Needlepoint Bipolar Ionization, https://www.total-mechanical.com/wp-content/uploads/2020/09/How-to-Make-Your-HVAC-Pandemic-Ready.pdf.
[67] Global Plasma Solutions, Independent Testing, https://globalplasmasolutions.com/independent-testing (last visited May 5, 2021).



ii.

62. Defendant's representations concerning the COVID-19 pandemic.[68]

a. "While the **COVID-19 pandemic** has inspired virtually every industry to take steps toward ensuring cleaner, safer indoor air, Global Plasma Solutions (GPS) began tackling air purification long before the coronavirus emerged."[69]

b. "**COVID-19 is top of mind**, of course, including the different mutations of the virus we're seeing come into the

[68] Emphasis added throughout.
[69] Global Plasma Solutions, *Project Spotlight: Edmonton International Airport*, https://globalplasmasolutions.com/articles/project-spotlight-edmonton-international-airport.

United States," Waddell said. "**NPBI creates additional peace of mind during this evolving pandemic.**"[70]

c. "**This pandemic may be the first most of us have seen, but it won't be the last**, and we need to be prepared. That's why GPS is committed to science and ongoing research to ensure we have the safest, most effective technology on the market."[71]

d. "Pathogens such as SARS-CoV2, **the new strain of coronavirus that causes COVID-19**, can reside on surfaces and be suspended in the air we breathe. NPBI technology is **designed to mitigate these harmful pathogens by safely creating and releasing ions** via a building's existing HVAC system."[72]

e. "In the case of **SARS-CoV2** and other pathogens, contact with positive and negative ions has microbicidal effects,

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[70] Global Plasma Solutions, *The Future of Indoor Air Quality Is Now*, https://globalplasmasolutions.com/articles/the-future-of-indoor-air-quality-is-now.
[71] *Id.*
[72] Global Plasma Solutions, *Why Better Indoor Air Quality May Be the Key to Safer Indoor Events*, https://globalplasmasolutions.com/articles/why-better-indoor-air-quality-may-be-the-key-to-safer-indoor-events.

ultimately disrupting their surface proteins and rendering them inactive. Independent laboratory studies have shown **that NPBI technology limits the spread of viruses such as SARS-CoV2**, MRSA and E. coli."[73]

f. "In addition, when ions come into contact with pathogens, such as the **SARS-CoV-2 virus that causes COVID-19**, they disrupt the pathogens' surface proteins. This, in turn, renders them inactive."[74]

g.

Pathogen	Time in Chamber	Rate of Reduction	Test Agency
SARS-CoV-2	30 minutes	**99.9%**	Innovative Bioanalysis

[75]

h. "Imagine an individual with **COVID-19** walks into a room in your office building. With the smallest of actions – like a cough or a sneeze – harmful pathogens have been released into the air. From that moment forward, anyone who walks into the room is exposed to the virus. These scenarios

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[73] *Id.*
[74] *Id.*
[75] Archived version of Defendant's website from October 24, 2020, https://web.archive.org/web/20201024175828/https://globalplasmasolutions.com/pathogen-reduction.

happen countless times each day, and historically there have not been solutions to address the problem. That's where NPBITM comes in." Charlie Waddell, GPS Founder and CTO.[76]

i. "Though **a proven tool in the fight against COVID-19**, NPBI is just one critical measure in a comprehensive approach to improving IAQ and providing cleaner, safer indoor air."[77]

j. "...announced today industry-leading ionization testing results, demonstrating a **99.4% reduction rate on a SARS-CoV-2 (COVID-19)** surface strain within 30 minutes, the **first instance in which an air purification company has effectively neutralized SARS-CoV-2.**"[78]

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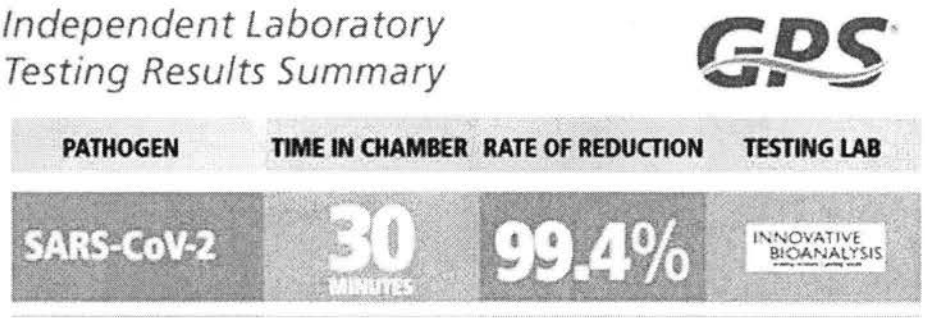
[76] Charlie Waddell, *The Future of IAQ Lies in Needlepoint Bipolar Ionization*, HVAC INSIDER & REFRIGERATION (July 7, 2020), https://hvacinsider.com/the-future-of-iaq-lies-in-needlepoint-bipolar-ionization/.

[77] Global Plasma Solutions, *Why Your Customers Should Care About Their Indoor Air Quality*, https://globalplasmasolutions.com/articles/why-your-customers-should-care-about-their-indoor-air-quality.

[78] Global Plasma Solutions, *GPS Virtually Eliminates Static SARS-CoV-2 with Proprietary NPBI Technology*, June 10, 2020, https://globalplasmasolutions.com/articles/gps-virtually-eliminates-static-sars-cov-2-with-proprietary-npbi-technology.

k.



63. Global Plasma Solutions' representations were largely repeated uncritically by news outlets, publications, press releases, social media, and other forms of media.

64. Global Plasma Solutions' representations were used in the marketing efforts of its sellers, distributors, and other agents.

65. But these representations failed to hold up when they were examined by independent academic studies and industry watchdogs.

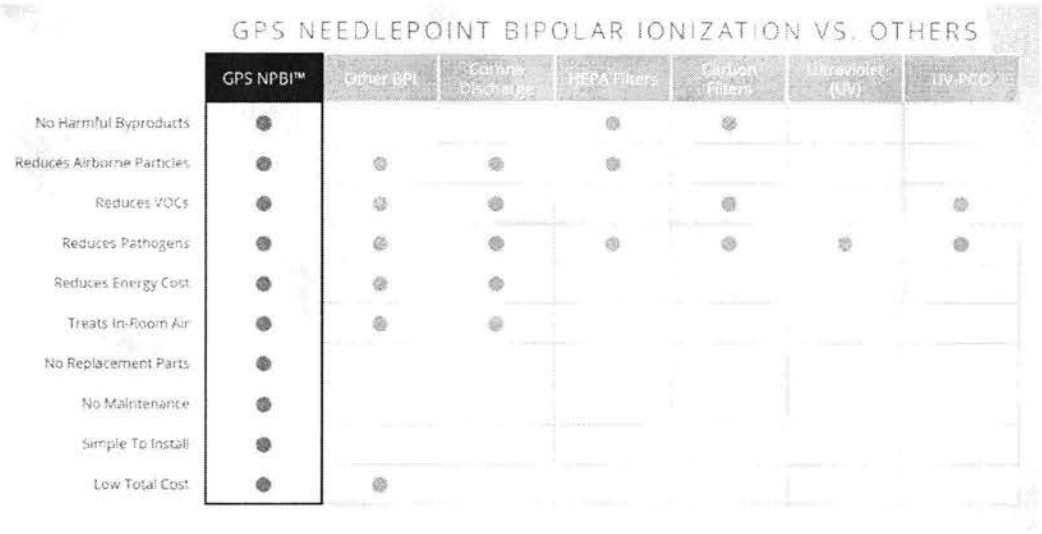
D. Global Plasma Solutions' Representations Are False, Deceptive, and Misleading

a. Global Plasma Solutions' Representations to Consumers that Its Products Are Superior to Other Air Treatment Systems Are False, Deceptive, and Misleading.

66. As outlined above, Defendant represents NBPI as the safest, most effective technology on the market.

67. These statements are not mere puffery because Defendant presents direct comparisons to other technologies throughout its uniform, wide scale marketing campaign.

68. For example, the following table is used multiple times in Defendant's marketing literature:



69. These statements are made by the Defendant in order to siphon sales from the competitors that use other technologies to clean the air.

70. If the statements were true and accurately represented, then Defendant's "superior technology" representations might be within the bounds of the law.

71. However, many of Defendant's representations are false, misleading, and deceptive.

72. For example, Defendant represents to consumers that NPBI does not produce harmful byproducts.

73. As outlined below, this statement is not true and is included in order to lure consumers that may be interested in competing technologies like HEPA filters and carbon filters which do not produce harmful byproducts.[79]

74. When NPBI is compared to other technologies, "[existing] proven measures that should be taken to address airborne transmission risk include properly sized and maintained ventilation (mechanical and natural), mechanical filtration (including portable HEPA filter units), and germicidal ultraviolet light systems. Such measures are practical and often can be easily implemented; many are not costly...."[80]

75. As described in greater detail below, many of these comparisons are false, misleading, and deceptive, and solely created to induce sales of Defendant's Products.

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[79] Professor Glenn Morrison from the University of North Carolina Chapel Hill notes that "[a] cheap portable HEPA filter would work many times better and have fewer side effects (possibly ozone or other unwanted chemistry)." Lauren Weber and Christina Jewett, *As Schools Spend Millions on Air Purifiers, Experts Warn of Overblown Claims and Harm to Children*, KAISER HEALTH NETWORK (May 3, 2021), https://khn.org/news/article/as-schools-spend-millions-on-air-purifiers-experts-warn-of-overblown-claims-and-harm-to-children/.

[80] Drs. Marwa Zaatari and Marcel Harmon, *Open Letter to address the use of Electronic Air Cleaning Equipment in Buildings*, April 12, 2021, https://medium.com/open-letter-to-address-the-use-of-electronic-air/no-to-ionizers-plasma-uvpco-bc1570b2fb9b (this letter is supported by 11 other doctors).

b. Global Plasma Solutions' Representations to Consumers that Its Products Will Safely Clean the Air and Eliminate VOCs with No Harmful Byproducts Are False, Deceptive, and Misleading.

76. In February 2021, professors at three major universities released an academic article that was selected for publication in the academic journal *Building and Environment.*[81]

77. The article examined the effectiveness of bipolar ionization technology. Specifically, Defendant's GPS-FC48-AC device was tested by the scientists.

78. The article concluded that "[t]he device in our testing was ineffective in addressing the air pollutants that it's advertised to remove from the space."[82]

79. After conducting its detailed experiments, the panel of scientists concluded that Defendant's GPS-FC48-AC device introduces harmful volatile organic compounds into the air.

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[81] Yicheng Zeng, Prashik Manwatkar, Aurélie Laguerre, Marina Beke, Insung Kang, Akram S. Ali, Delphine K. Farmer, Elliott T. Gall, Mohammad Heidarinejad, Brent Stephens, *Evaluating A Commercially Available In-Duct Bipolar Ionization Device For Pollutant Removal And Potential Byproduct Formation*, BUILDING AND ENVIRONMENT, Volume 195, 2021, 107750, ISSN 0360-1323, https://doi.org/10.1016/j.buildenv.2021.107750.

[82] Keely Chalmers, *Researchers Warn Against Some Electronic Air Purifiers*, KGW8 (April 15, 2021), https://www.kgw.com/article/news/health/researchers-warn-against-some-electronic-air-purifiers/283-1da342a6-75ca-4ca3-aa82-c4e4717fc491.

80. The article notes:[83]

> Both the chamber and field tests suggested that the use of the tested bipolar ionization unit led to a decrease in some hydrocarbons (e.g., xylenes) among the lists of compounds we were able to analyze, but an **increase in others, most prominently oxygenated VOCs (e.g., acetone, ethanol) and toluene.**

81. In other words, Defendant's GPS-FC48-AC device does not clean the air and produce a healthy environment. Rather, it trades one group of harmful chemicals for another group of harmful chemicals.

82. The study showed the following increases in Acetone, Ethanol, Toluene, and Butyraldehyde.[84]

83. **Acetone** is a toxic substance.

a. According to the CDC, inhalation of Acetone can cause the following ailments:[85]

i. nose, throat, lung, and eye irritation;

ii. headaches;

iii. light-headedness;

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[83] Zeng, Manwatkar, et. al., *supra* note 76.
[84] Other toxic substances may be produced by Defendant's Products. Plaintiff's investigation is ongoing and will seek to amend the Complaint to specify other potential toxic substance produced by these Products in the future.
[85] Center For Disease Control and Prevention, *Acetone: ATSDR Fact Sheet*, September 1, 1995, https://wonder.cdc.gov/wonder/prevguid/p0000467/p0000467.asp.

iv. confusion;

v. increased pulse rate;

vi. effects on blood;

vii. nausea;

viii. vomiting;

ix. unconsciousness and possibly coma; and

x. shortening of the menstrual cycle in women.

b. Additional evidence shows that "Acetone may damage the male reproductive system (including decreasing the sperm count) and affect female fertility in animals."[86]

c. Acetone is toxic to the central nervous system.[87]

d. Acetone is toxic to the kidneys, the liver, the skin, and the reproductive system.[88]

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[86] New Jersey Department of Health, *Hazardous Substance Fact Sheet: Acetone*, June 2015, https://www.nj.gov/health/eoh/rtkweb/documents/fs/0006.pdf.
[87] ScienceLab.com, *Material Safety Data Sheet Acetone MSDS*, November 6, 2008, https://www.conncoll.edu/media/website-media/offices/ehs/envhealthdocs/acetone.pdf.
[88] New Jersey Department of Health, *Hazardous Substance Fact Sheet: Acetone*, June 2015, https://www.nj.gov/health/eoh/rtkweb/documents/fs/0006.pdf.
[88] ScienceLab.com, *Material Safety Data Sheet Acetone MSDS*, November 6, 2008, https://www.conncoll.edu/media/website-media/offices/ehs/envhealthdocs/acetone.pdf.